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(71) Applicant: SUMMIT TELECOM SYSTEMS, INC. [US/US]; 332 Springfield Avenue, Summit, NJ 07901 (US).

(72) Inventors: JOHNSON, Jack, J.; 60 Blackburn Place, Summit, NJ 07901 (US). COYLE, William, F.; 22 Valley View Avenue, Summit, NJ 07901 (US).

(74) Agent: FRIEDMAN, Allen, N.; McCarter & English, Four Gateway Center, 100 Mulberry Street, Newark, NJ 07101-0652 (US).

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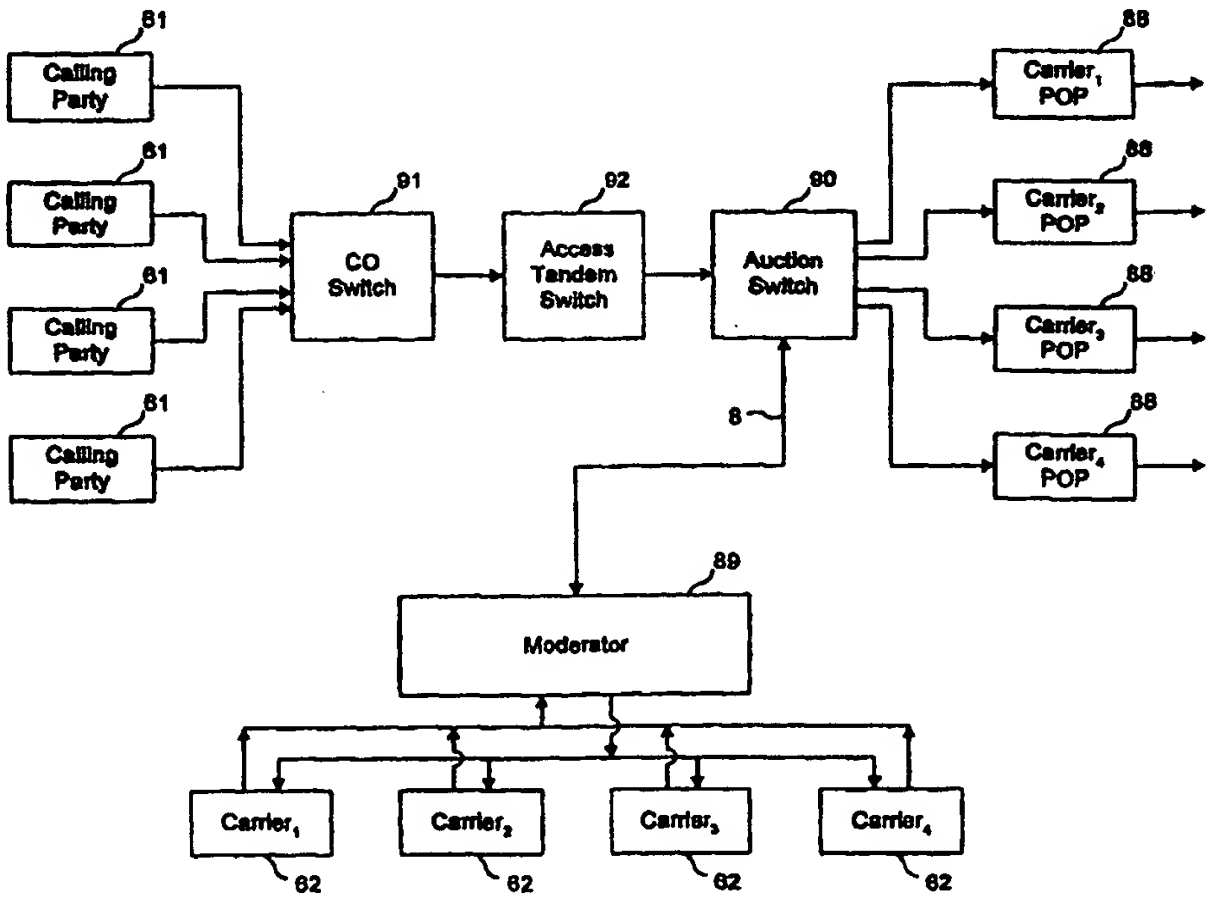
(54) Title: BIDDING FOR TELECOMMUNICATIONS TRAFFIC

(57) Abstract

Telecommunications switches route calls in accordance with economic incentives (e.g., least cost routing) resulting from an auction process between participating telecommunications carriers (carriers) (62) by operation of a central processor, a computer referred to as a bidding moderator (moderator) (89). Each of the carriers (62) bidding for traffic informs the moderator (89) of the rate it is willing to charge (or other economic incentive it is willing to offer) for service at some particular time between two specific switching points, defining a route or route segment, in one or more telecommunications networks. This "bid" rate may be lower than that carrier's established rate for any of several reasons (e.g., the carrier has excess capacity on that route or route segment at that time). The carrier (62) may change its bids as often as it likes as traffic patterns change. The moderator (89) collects this bid information from all the carriers (62), processes the bid information and transmits carrier selection information to subscribing switches implementing an auction service. Bid information is also transmitted to participating carriers' network management centers. From the list of all carriers (62) providing bid information to the moderator (89), each subscribing switch can select those carriers (62) to which it wants traffic routed and can change that selection at any time.



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BIDDING FOR TELECOMMUNICATIONS TRAFFIC

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is in the field of telecommunication network control.

2. Description of the Background Art

Many locally managed telecommunication systems, such as PBXs, employ "least cost routing" software to reduce telecommunication costs. The system's manager arranges with more than one interexchange carrier to carry the system's traffic from the local exchange to which it is connected to other exchanges. The manager keeps track of each carrier's charges and populates the routing table in the "least cost routing" software. The charges may be the regularly tariffed charges of the subscriber's primary carrier or contracted charges offered by an alternate carrier for a bulk discount or for discounting traffic during a specific time period during the day. The "least cost routing" software will examine each call attempt and automatically decide which carrier is the best economic choice for that call. If the call attempt fails, the software usually defaults the call attempt to the subscriber's primary carrier.

Telecommunication carriers regularly enter into wholesale contractual arrangements with other carriers to use part or all of such other carriers' telecommunications networks, for example, to complete calls to geographic regions the first carrier does not serve or to provide additional capacity on routes, or portions of routes, for which the first carrier may have little or no available capacity on its own network facilities at that time.

Recently a great deal of competition has developed between telecommunication carriers. This has been stimulated by both regulatory and technological changes. As telecommunication becomes more of a commodity it would be of great benefit to consumers to stimulate this competition and facilitate both a carrier's and a consumer's ability to make economic choices between telecommunication carriers.

SUMMARY OF THE INVENTION

Provision of telecommunication services is presently dominated by fixed contractual relationships, between service providers on a wholesale basis and between users and service providers on a retail basis. However, because of technological and regulatory changes, telecommunication service is becoming more of a commodity, with competition between service providers for traffic. The herein disclosed invention stimulates this competition and facilitates a service provider's and a consumer's ability to make economic choices between competing

telecommunication carriers. In this method and system, telecommunication switches route calls in accordance with economic incentives (e.g., least cost routing) resulting from a bidding process between participating telecommunication carriers (Carriers), administered by a bidding service provider through operation of a central processor, a computer referred to as a bidding moderator (Moderator).

In this arrangement, each of the Carriers transmits to the Moderator the rate it is willing to charge (or other economic incentive it is willing to offer) for service between two specific switching points on one or more telecommunications networks, at some particular time. This "bid" rate may be for a route or a route segment. For purposes of differentiating in this document between a route and route segment, a "route" is service from the "originating switching point," i.e., the switching point on a telecommunications network that serves as the most immediate switching interface between the calling party and that telecommunications network (e.g., a local exchange switch or equivalent local switching node, whether hardware or software-defined, providing access to that network), to the "terminating switching point," i.e., the switching point on a telecommunications network (which may, but need not be, owned or operated by the same carrier who owns or operates the originating switching point) that serves as the most immediate switching interface between the called party and that telecommunications network (e.g., a local exchange switch or equivalent local

switching node, whether hardware or software-defined, providing access to that network). A "route segment" is any and all of the following: (i) service from an originating switching point on a telecommunications network to an "intermediate switching point" on the same or different telecommunications networks, such "intermediate switching points" being all switching points on one or more telecommunications networks that do not serve as the most immediate switching interface between the calling party and a telecommunications network or the most immediate switching interface between the called party and a telecommunications network, but do serve as switching points elsewhere in the telecommunications network or networks over which a call attempt may be routed (e.g., a tandem switch, a high-speed router or some other hardware or software-defined intermediate switching node on a telecommunications network); (ii) service from one intermediate switching point on a telecommunications network to another intermediate switching point on the same or different telecommunications networks; and (iii) service from an intermediate switching point on a telecommunications network to a terminating switching point on the same or different telecommunications networks.

Carriers may submit bids for routes or route segments to the Moderator for different types of telecommunications network (e.g., circuit-switched, frame relay, asynchronous transfer mode, packet data networks such as the Internet, etc.) and for different classes of telecommunications service provided

by such networks (e.g., transmission of voice, data, video, etc.). Access to such telecommunications networks or facilities by end users or by other telecommunications carriers or service providers may be, for example, via the public switched telephone network, dedicated facilities, private lines, wireless facilities, coaxial cable, electric utility power lines, Ethernet or other local area network (LAN), metropolitan area network (MAN) or wide area network (WAN) connections.

The bid rate may be lower than that Carrier's established rate for any of several reasons (e.g., the Carrier has excess capacity on a particular route or route segment at that time). The Carrier may, for example, also decide for capacity or competitive reasons to place the same bid (i) on all traffic having the same originating switching point (e.g., an NPA-NXX) independent of terminating switching point or independent of which intermediate switching points such traffic may pass through, or (ii) on all traffic having the same terminating switching point independent of originating switching point or independent of which intermediate switching points such traffic may pass through. The Carrier may change its bids as often as it likes during the day as traffic patterns change. The Moderator collects this bid information from all the Carriers, sorts it among switching points, and may further process this bid information, for example, to select Carriers for particular routes or route segments or for individual calls. This carrier selection information may include, for example, a prioritization of the

Carrier selection in accordance with Carriers' bids for each route or route segment or the designation of a selected Carrier and, perhaps, a default Carrier. The Moderator then transmits selected portions of this information to each appropriate subscribing switch location and to participating Carriers' network management centers. Each subscribing switching point (a "Subscriber") gets the rate information or carrier selection information from the Moderator for all "point-to-point" routes or route segments for service from the Subscriber to all other switching points. The Moderator provides each Carrier with bid information from other Carriers for at least a portion of all "point-to-point" routes or route segments for which any Carrier has submitted a bid (e.g., any originating NPA-NXX to any other NPA-NXX or to any intermediate switching point on the public switched telephone network in the world). A route or route segment may be entirely contained within a single local exchange area.

From the list of all Carriers providing bid information to the Moderator, each Subscriber can select those Carriers to which it wants traffic routed and can change that selection at any time. The Subscriber downloads the bid information and/or carrier selection information of those selected Carriers into the routing tables in its switch. After each new bid is submitted by a Carrier and is processed by the Moderator, the rate and/or carrier selection information will be distributed to the relevant Subscribers and rate information will be distributed to other Carriers. The Carriers receiving the information will have the opportunity

thereafter to submit a lower or higher bid for any point-to-point route or route segment on which they wish, respectively, to stimulate or discourage additional traffic.

Similarly, the Moderator could offer a different class of service directly to end users who are calling parties. As part of such a service, Carriers would provide an economic incentive for all such end users in a given local exchange area (e.g., an NPA-NXX or group of NPA-NXXs served by a switch) to originate calls terminating anywhere (e.g., by means of a low rate or stated discount). In that case the Moderator would broadcast (e.g., by wired data link or wireless transmission) rate information or carrier selection information generated by the Moderator to an interface unit at each end user location. The information may be displayed for evaluation by the end user or processed within the interface unit, with direction from the end user, and all outgoing calls routed to the selected Carrier. If the Carrier information is displayed for the end user, the user can choose a Carrier for a call attempt and key in the selected Carrier's Carrier identification code before the desired destination address (e.g., telephone number). If the information is processed automatically within an interface unit in the line between the user's terminal equipment and the local exchange switch, the interface unit can, for example, automatically insert the appropriate Carrier identifier before outgoing telephone numbers.

Through this bidding process, Carriers can compete for traffic on selected routes or route segments, or compete for traffic originating from selected points, in telecommunication networks. They can also manage their network traffic by adjusting their bids from time to time, depending on network traffic information or other network information. And users as well as other telecommunication service providers (who may, for example, wish to use the bidding process to obtain a lower rate for resale to customers) can easily make economic choices.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view of an exemplary system of the invention showing dedicated communications lines from each Carrier to the Moderator, from the Moderator to each of the subscribing switches, and a common data link from the Moderator to each of the Carriers.

Figure 2 is a schematic view of an exemplary system of the invention showing the Carriers using a shared data link to provide information to the Moderator.

Figure 3 is a schematic view of an exemplary system of the invention showing switched access from the Moderator to each of the subscribing switches and to each Carrier.

Figure 4 is a schematic view of an exemplary system of the invention showing use of a shared data facility, such as a local area network, for communication from the Moderator to each of the subscribing switches and to each Carrier.

Figure 5 is a schematic representation of an exemplary process of the invention showing transmission of bid information from the Moderator to the subscribing switches.

Figure 6 is a schematic view of an exemplary system of the invention in which the Moderator transmits data directly to the switches.

Figure 7 is a schematic view of an exemplary system of the invention in which the Moderator transmits data to a computer associated with a plurality of switches.

Figure 8 is a schematic representation of an exemplary process of the invention in which the Moderator generates carrier selection data for the subscribing switches.

Figure 9 is a schematic view of an exemplary network architecture in which routing decisions can be made at originating and intermediate switching points to select different route segments for call attempts presented to such switching points, based on data received from the Moderator.

Figure 10 is a schematic view of an exemplary network architecture in which a Moderator transmits data to a dedicated facility switch.

Figure 11 is a schematic representation of an exemplary process of the invention, including a billing capability.

Figure 12 is a schematic representation of an exemplary process of the invention showing transmission of information from the Moderator directly to end users.

Figure 13 is a schematic view of an exemplary end user portion of a system of the invention.

Figure 14 is a schematic representation of an exemplary network architecture showing transmission of bid information from the Moderator to a subscribing switch receiving call attempts from a local exchange switch.

Figure 15 is a schematic view of an exemplary network architecture showing transmission of bid information from the Moderator to a subscribing switch receiving call attempts from a local exchange telephone carrier's access tandem switch.

Figure 16 is a schematic representation of an exemplary network architecture in which the Moderator transmits data to a local exchange switch of a local exchange telephone carrier.

Figure 17 is a schematic view of an exemplary network architecture in which the Moderator transmits data to an access tandem switch of a local exchange telephone carrier.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an exemplary system for carrying out the herein disclosed bidding process for telecommunication services, in which a Moderator 1 administers collection and dissemination of bidding information. The Moderator 1 includes a computer with a processor and memory, together with input and output devices to communicate with the Carriers' network management computers 2, which are the source of the bidding information, and the subscribing switches 3 (Subscribers), which are the ultimate users of the bidding information.

The Carriers are, primarily, Carriers that carry telecommunication traffic between switching points (e.g., originating and terminating switching points such as local exchange switches or equivalent local switching nodes) on telecommunications networks. By means of the Figure 1 system, for example, the Carriers bid for traffic from subscribing switches 3, associated with a switching point on a telecommunications network, to other switching points on the same or different telecommunications networks. Some circumstances may result in the bidding process controlling carriage of a call over a route or route segments within a single local exchange area. A local exchange area is, typically, the geographic region served by a local exchange switch (or equivalent local switching node). The Carriers transmit their bids from their network management computers 2 over data links 7, which may be either analog (using modems) or digital. However, the

information is usually transmitted in digital form for input into the Moderator 1. Each Carrier has a network administrator who enters network management instructions into each network management computer 2 through input port 6 by means, for example, of a keyboard or a data link from a remote site or local computer.

Carriers may submit bids for routes or route segments to the Moderator for different types of telecommunications networks (e.g., circuit-switched, frame relay, asynchronous transfer mode, packet data networks such as the Internet, etc.) and for different classes of telecommunications service provided by such networks (e.g., transmission of voice, data, video, etc.). Access to such telecommunications networks by end users or by other telecommunications carriers or service providers may be, for example, via the public switched telephone network, dedicated facilities, private lines, wireless facilities, coaxial cable, electric utility power lines, Ethernet or other local area network (LAN), metropolitan area network (MAN) or wide area network (WAN) connections.

The Moderator 1 receives the bids, processes them in its processor, for example, sorts them by originating point or to produce carrier selection data, and enters both into a database in its memory by means of the data buses and registers internal to a computer. The carrier selection data, applicable to each Subscriber 3, are transmitted to such switch 3, perhaps by way of a computer 4 adjunct to the switch 3 over a data link 8. The data link 8 is illustrated as a

dedicated transmission facility between the Moderator 1 and each switch 3. However, any other transmission technology offering a selective way to transmit data from the Moderator 1 to the switch may be used. (A "transmission facility" is a telecommunication path or channel. It may be, for example, a wired link, a radio channel in a wireless system, or a time slot in a digitally multiplexed optical transmission system). The data inputs and outputs of the Moderator 1, the network management computers 2, the adjunct computers 4, and the switches 3 are implemented by such devices as interfaces, registers and modems that are well known in the art.

As illustrated in Figure 6, the Moderator 1 processes the bids to prioritize them for each route or route segment, producing derivative data, including carrier selection data. This data can reflect, for example, designation of a selected Carrier and alternate Carriers, based on the Carriers' bids for each route or route segment. The Moderator 1 transmits the applicable bids and/or the derivative data to the switch 3. The Moderator 1 or the switch 3 can also designate a default Carrier in the event a call cannot be completed via a Carrier selected by the bidding process. The switch 3 can also be equipped to override the Moderator's selection in accordance with decision rules from the switch administrator 5 (e.g., if the default Carrier designated for the switch 3 charges a rate lower than the lowest bidding Carrier).

An adjunct computer is known in the art to be a computer, closely associated with a switch, that provides the switch's operating software additional data or operating logic to provide the switch with additional operational capability. In the herein disclosed architecture, while primary processing of the bid data to produce carrier selection data is performed in the Moderator, as illustrated in Figure 1, the adjunct computer 4 can be employed to enter the carrier selection data received from the Moderator 1 into a database in its memory and receive, through input port 5, decision rules from the switch administrator. Software in the adjunct computer's processor can then access the data in memory and apply the decision rules to the carrier selection data, producing the data required to populate the routing tables of the least cost routing software in the switch 3. The adjunct computer 4 communicates with the switch 3 over a digital data link or data bus 11. If the switch 3 has enough processing capacity, the function of the adjunct computer 4 may be incorporated in the switch's processor and memory, the function being implemented in the processor by appropriate software. In this case the switch must also provide input ports to receive transmission link 8 and input 5 from the switch administrator. Each switch 3 receives call attempts over incoming lines 12. Each call attempt includes routing data identifying the call's destination. The switch's least cost routing software then selects the Carrier to which the call attempt shall be routed over outgoing line 13.

In the implementation illustrated in Figure 7, an adjunct computer 71, perhaps belonging to a local exchange carrier, receives the carrier selection data from the Moderator 1, further processes the data and controls Carrier selection in the switches 73 under its control. Routing tables in the switches 73 can be populated periodically by data from the adjunct computer 71 or the switch 73 can query the adjunct computer 71 as each call attempt is presented. The adjunct computer 71 can receive selection rules and other administrative directions from a local carrier administrator 70.

An alternative for end users to use of a PBX, a private switch, is subscription to Centrex service, in which the end users' originating switching point is a software-defined portion of the local central office switch of the local exchange telephone carrier. With data links between the adjunct computer 4 and the local central office switch, the end users' switch administrator can administer the end user portion of the processing capability of the bidding process in much the same way as if a PBX were being administered. In addition, instead of using a PBX or subscribing to a Centrex service, a residential or business customer could subscribe to a "least cost routing" feature offered by the local exchange telephone carrier as part of its enhanced calling services (currently including call waiting, call forwarding, 3-way calling, speed dialing, etc.). As with Centrex service the end users' switch enabling these enhanced calling features is a software-defined portion of the processing capability of the local central office switch.

The Moderator 1 also transmits received bids to the network management computers 2 of Carriers over the data link 9, 10. The exemplary architecture of Figure 1 shows a combination of a single output data link 9 and individual Carrier input links 10 for this Moderator-to-Carriers bid data, indicating that the Moderator 1 may send the same data to all Carriers. There are many alternate transmission technologies available to transmit this bid data to all Carriers, including dedicated bidirectional links between the Moderator 1 and each Carrier, combining the function of links 7, 9, and 10.

Depending on the particular implementation, it may be appropriate to transmit all received bids to all Carriers. However, for example, each Carrier's bids need not be transmitted back to the bidding Carrier and there may be Carriers with limited service areas that are not interested in receiving bids from out-of-area Carriers. In any event, at least a portion of the bids are transmitted to a least a portion of the Carriers in order to implement an auction.

Figure 2 illustrates an alternative network architecture in which the individual Carrier-to-Moderator data links 14 share a common data input line 15 into the Moderator 1. This can be done, for example, by means of fiber optics using the SONET transmission protocol and ATM technology. This would require an ATM switching module at each junction 16 between the individual Carrier links 10, 14 and the common Moderator input-output links 9, 15. Figure 2 illustrates bidirectional transmission using two transmission paths. However,

such bidirectional transmission can be implemented over a single physical transmission line.

Figure 3 illustrates an architecture incorporating switched access from the Moderator 1 to the switches 3. In this architecture a single Moderator output link 17 transmits each subscribing switch's bid data to a switch 18, which may be a dedicated switch or part of a public switched network. The bid information appropriate to each subscribing switch 3 is switched to each individual switch data link 8.

Figure 4 illustrates use of shared facilities between the Moderator 1 and each of the switches 3 and the Carriers' network management computers 2. This could be accomplished, for example, by many known local area network (LAN), metropolitan area network (MAN), and wide area network (WAN) technologies.

The economic choices presented to telecommunication service users under this invention depend on bids submitted by Carriers for telecommunication traffic over the routes or route segments they serve as part of the various telecommunication networks available to the users. For purposes of differentiating in this document between a route and route segment, a "route" is service from the "originating switching point," i.e., the switching point on a telecommunications network that serves as the most immediate switching interface between the calling party and that telecommunications network (e.g., a

local exchange switch or equivalent local switching node, whether hardware or software-defined, providing access to that network), to the "terminating switching point," i.e., the switching point on a telecommunications network (which may, but need not be, owned or operated by the same carrier who owns or operates the originating switching point) that serves as the most immediate switching interface between the called party and that telecommunications network (e.g., a local exchange switch or equivalent local switching node, whether hardware or software-defined, providing access to that network). A route may also have an originating point and a terminating point in the same local exchange area.

A local exchange switch (or equivalent local switching node) is generally considered to be (i) the switching point on a telecommunications network that serves as the most immediate switching interface between the calling party and that telecommunications network as well as (ii) the switching point on a telecommunications network (which may, but need not be, owned or operated by the same carrier who owns or operates the originating switching point) that serves as the most immediate switching interface between the called party and that telecommunications network, regardless of whether such telecommunications networks use circuit-switched, frame relay, asynchronous transfer mode, packet data, TCP/IP protocols or other current or evolving telecommunication technologies. Local exchange switches (or equivalent local switching nodes), for example, may include telephone companies' local central office switches, private

telecommunications networks' local access nodes, and Internet service providers' local access switches - whether represented by a server, router or other switching device (which may be hardware or software-defined), but in each case providing access to the respective telecommunications network.

To identify originating and terminating switching points for telephone calls within North America, for example, each local exchange switch on the public switched telephone network is designated in the North American Numbering Plan by a unique NPA-NXX code, where the NPA is a three digit numbering plan area identifier (e.g., area code 201 identifies Northern New Jersey) and NXX is a three digit code identifying a particular local exchange switch within the numbering plan area. It is common for a single local exchange switch to house more than one NXX Code. The interexchange Carriers that utilize this bidding process are usually identified by a Carrier access code. This code may be, for example, a "1" signifying the end user's presubscribed or primary Carrier, a 5 digit code "10XXX" for a Carrier other than the end user's primary Carrier, or some other code or data element designated for that purpose. Once a Carrier is selected for a call attempt, the appropriate Carrier access code may be inserted in the call attempt's routing data (e.g., NPA-NXX-XXXX, the last four digits identifying the particular line served by the called party's NPA-NXX switch on the public switched telephone network).

The subscribing switch may also have dedicated direct links to one or more Carrier points of presence on any telecommunications network. If such a Carrier is selected, the subscribing switch would route the call attempt directly to that dedicated link (without, for example, being handled by the local exchange switch that may otherwise serve that subscribing switch).

While the currently predominant numbering scheme for originating and terminating switching points on the public switched telephone network is the North American Numbering Plan, other numbering schemes identifying originating switching points and terminating switching points are possible, particularly for other types of telecommunication networks, and may be used as telecommunication technology evolves. International telephone calling, for example, currently uses a country code and a city code before the code that identifies the local exchange switch on the public switched telephone network.

A "route segment" is any and all of the following: (i) service from an originating switching point on a telecommunications network to an "intermediate switching point" on the same or different telecommunications networks, such "intermediate switching points" being all switching points on one or more telecommunications networks that do not serve as the most immediate switching interface between the calling party and a telecommunications network or the most immediate switching interface between the called party and a telecommunications network, but do serve as switching points elsewhere in the

telecommunications network or networks over which a call attempt may be routed (e.g., a tandem switch, a high-speed router or some other hardware or software-defined intermediate switching node on a telecommunications network); (ii) service from one intermediate switching point on a telecommunications network to another intermediate switching point on the same or different telecommunications networks; and (iii) service from an intermediate switching point on a telecommunications network to a terminating switching point on the same or different telecommunications networks. A route segment may also be entirely contained within one local exchange area. Each intermediate switching point in a telecommunications network has a unique identifier that is used in routing calls over route segments. Those identifiers can be used by the Moderator and the Carriers to manage the bidding process.

The competing Carriers bid for traffic by transmitting to the Moderator the economic incentive each Carrier will offer for traffic over each route or route segment it serves (or, at least, each route or route segment it wishes to compete for using the bidding process). The economic incentive presently contemplated as being most usual is the rate (amount of money charged per unit of time). However, many other kinds of economic incentive may be offered, such as a credit toward other services or a credit toward an additional rebate that may be offered if a user's traffic for a given month (or that of another telecommunication service provider reselling, for example, a Carrier's service between two switching

points on that Carrier's telecommunications network facilities) rises above a threshold. The economic incentive could be a combination of rate and another incentive. But the economic incentive should be selected from a limited set authorized by the provider of the bidding mechanism, because the incentive must be capable of being evaluated by the software in the Moderator or in each subscribing switch's adjunct computer. A Carrier may wish to submit more than one bid for routes or route segments that start at switching points at which it offers more than one class of service (e.g., switched service to some subscribers, dedicated access to others, high-speed service to still others, or combinations of different classes of service to some users). Each bid must be associated with a time period within which the bid will be effective.

The rules of the bidding process can be structured in many ways. The following are examples of possible bidding rules.

a) The day is divided into blocks of time by the bidding service provider and bids are submitted for each block of time. All bids for a given block of time must be submitted prior to a cut-off time that precedes that block of time by a protection interval. Any bid received after the cut-off time is considered to be effective for the next block of time, unless a new bid is subsequently received from the same Carrier for that route or route segment. The protection interval is needed to permit processing of the bid information by the Moderator and transmission of carrier selection data or bid information to the switch (or its

associated adjunct computer) prior to the bid's start time. For example, if thirty minute blocks of time are auctioned, a five minute protection interval may be appropriate.

b) Carriers are permitted to submit bids for any time interval by specifying a start time and a termination time or a start time and a good-until-cancel instruction. However, no bid can be effective before a protection time interval specified by the bidding service provider. The bidding service provider can provide confirmation of received bids back to the Carrier if the data link from the Moderator to the Carriers is provided with a selective messaging capability.

c) Carriers may be permitted to enter default bids for any route or route segment and/or block of time for which they transmit no other bid.

d) As a fail-safe mechanism, to avoid use of old bids that have not been changed due to communication failure, the Moderator may impose a rule setting a time limit (a fail-safe protection time) to the applicability of any bid. At the expiration of the time limit, the expired bid could default to a preset default bid or to no bid. Such a rule could also be built into the switch software to protect against a failure in the Moderator-to-switch data link.

The principal data feedback from the Moderator to the Carriers is transmission of bidding data from the Moderator to each of the Carriers. This permits the Carriers to adjust their own bids for any particular route or route segment in view of other Carriers' bids for that route or route segment. In a block

of time bidding scheme this transmission may take place, in different service offerings, either before or after the bid cutoff time for a given block of time. If transmitted before the cutoff time, the Carriers have an opportunity, up to the cutoff time, to adjust their bids for that block of time. If the service is arranged for transmission back to the Carriers after the cutoff time, the Carriers can adjust their bids for the next or subsequent blocks of time. If the bids are transmitted back to the Carriers after the cutoff time but before the bid's effective time, the Carriers would be able to manage their networks to take account of that time interval's bid structure. The bids can be adjusted to be higher or lower, dependent on whether the Carrier, in view of the state of its network traffic, wishes to further encourage or discourage additional traffic. The Carrier may wish to reduce its bid , for example, to encourage additional traffic on an underutilized telecommunication facility, or increase its bid to discourage traffic over a facility approaching a congested state. Depending on the transmission and computer technologies used, transmission back to the Carriers could also be accomplished by posting the bids on a bulletin board system, making them available for retrieval by all Carriers.

An evolutionary development in local exchange switch architecture is the combination of a "dumb" switch and a "smart" peripheral computer. In this arrangement the switch accomplishes the actual connection between incoming and outgoing telecommunication facilities and the switch operating software performs

the management functions specifically supporting the switching function. The peripheral computer contains the service-related software. This arrangement permits the telecommunication service provider to modify its service offerings without the need to ask the switch manufacturer to change the switch's operating software. Through use of an intelligent peripheral computer, one service that could be offered to all subscribers, including most businesses and individuals, is least cost routing. As in PBX least cost routing, the routing of a call attempt is dependent on population of a routing table. This table is a memory file containing the cost (or other economic incentive) of call carriage over each route accessed by the switch or other carrier selection data. In accordance with the herein disclosed process, this routing table could be populated by the Moderator, based on carrier selection data it generates, or by a computer adjunct to the switch, based on decision rules entered by a switch administrator. Or, with appropriate software, the adjunct computer function could be incorporated in the switch's peripheral computer. With this combination of software implementations, a telecommunication service provider could offer a least cost routing service, at economically advantageous rates based on a bidding process, to all of its customers.

As illustrated in Figure 8, the routing table can be populated with derivative data generated 75 in the Moderator by further processing of the economic incentive data. This could include carrier selection data, prioritizing the

Carrier selection in accordance with Carriers' bids for each route or route segment starting at that switch. The applicable data can be transmitted 76 to each switch, including those in which the adjunct computer populates the switch's routing table 80. While some of the decision making process has been performed by the Moderator (i.e., sorting its bids and generating carrier selection data), the switch makes the ultimate Carrier selection 81 based on network conditions and decision rules from the administrator 77. The network architecture involved is as illustrated in Figure 6, where the switch 3 represents the combination of the dumb switch and the intelligent peripheral computer and the input and output links 12, 13 represent all of the telecommunication facilities accessed by the switch 3. Another arrangement contemplated by the bidding process is for a local exchange carrier, controlling several switches, to receive the bidding or routing data for all its switches and further process that data for all of its switches.

The bid information being transmitted between the Moderator, the Carriers, and subscribing switches is sensitive business information and may need, under various circumstances, to be encrypted. Depending on how the service is arranged, there may be a need to protect the privacy of bids from interception by other participating Carriers or from interception by non-participating carriers. Some of the most sensitive information would be bid information sent from the Carriers to the Moderator, bid confirmation messages from the Moderator to the Carriers, and carrier selection data sent from the Moderator to the subscribing

switching points. Some less sensitive information would be the bids broadcast back to all participating Carriers after the cutoff time for a given block of time. There are several encryption schemes known in the art for such use, including the RSA and PGP schemes.

Figure 5 illustrates an exemplary implementation of the bidding process of this invention. The process is carried out by participating Carriers, acting through their network management computers, the bidding service provider, acting through the Moderator computer, and the subscribing switches. The Carriers' primary purpose is to maximize revenue from the carriage of telecommunication traffic over their networks. The subscribing switches are usually managed to obtain telecommunication service most economically.

In operation of this exemplary bidding process, the Moderator receives bids 20 from each Carrier specifying the economic incentive the Carrier is willing to offer for carrying a call over each route or route segment for which it wishes to place a bid. This information is stored in the computer's memory. At a time appropriate to the particular service arrangement in operation, the Moderator transmits 21 bids received from the Carriers to at least a portion of the Carriers. The Moderator also processes the data in a sorting operation to determine which bids and/or carrier selection data derived from the bids are for routes or route segments that have a starting point associated with each subscribing switch and the Moderator transmits 23 the appropriate bids to each such switch.

Each subscribing switch is operated by a switch administrator that formulates 29 the decision rules. A decision rule may be, for example, a simple instruction to switch a call attempt to the Carrier that has submitted the lowest cost bid. The rules may include, for example, an instruction to route all calls in a particular time period (e.g., from midnight to 6:00 A.M.) to a particular Carrier to satisfy the requirements of a contract between the switch's owner and that Carrier, or because this contract Carrier has contracted to carry all traffic during that time period for a flat monthly fee. At all other times, the decision rules might include an instruction to route calls to this contract Carrier only if its contract rate is lower than the lowest bid submitted to the Moderator by the other Carriers. The switch administrator may also instruct the switch or an associated adjunct computer to value a non-rate economic incentive in a particular way. The bids and decision rules are received by the switch or associated adjunct computer and stored in a data base in its memory. The switch or associated adjunct computer applies 31 the decision rules to the economic incentive data received as bids and generates the carrier selection data needed to populate the switch's routing table. The decision rules may be transmitted to the Moderator and the carrier selection data can be generated in the Moderator. The carrier selection data can be transmitted to the switch periodically, when generated, or in response to a query from the switch. The query can call for the carrier selection data in full or on a call-by-call basis. The routing table is the file that is accessed by the switch's least cost

routing software to decide which Carrier will receive a call attempt. The software will also provide for treatment of failed call attempts (e.g., retry, try the next lowest cost Carrier, or default to the contract Carrier). When a call attempt is presented to the switch, a routing decision is made and the call routed 33 to a Carrier for transmission to the call's destination or to an intermediate switching point. In order to route a call, the subscribing switch's operating software connects the input register carrying the call attempt to the output register connected to telecommunication facilities which connect to the selected Carrier for that route or route segment.

To reduce the exposure of end users (and resellers) to the potential volatility of prices offered via the bidding process, default Carriers may participate. If, for example, prices bid in the auction rise above a fixed upset price previously agreed to by the default Carrier, the Moderator could select the default Carrier as the winning bidder. The Moderator or owner of the subscribing switch may negotiate with one or more Carriers to serve as default Carriers. In the alternative, an end user or group of end users (or a reseller) may wish to specify to the Moderator or owner of the subscribing switch that a particular Carrier be designated as that end user's or reseller's default Carrier (e.g., a telecommunications service provider who has entered into a contract with the end user to carry a significant portion of that end user's telecommunications traffic outside of the bidding process).

The Moderator can also accommodate end users (and resellers) who wish to limit the group of Carriers from whom the Moderator will evaluate bids when a Carrier is to be selected for call attempts by such end users (or customers of such resellers). An end user (or reseller) may wish to request of the Moderator (or a subscribing switch's administrator) that each of its calls be routed only to one of a set of Carriers specified by that end user (or reseller). The Moderator, in compliance with this request, will include the bids of only this set of specified Carriers when generating carrier selection data for call attempts by such end users. The subscribing switch, when presented with a call attempt by such an end user, can include the calling party identifier as part of a query made by the switch to the Moderator for carrier selection data for this call. The Moderator can then associate this calling party identifier with data in its memory that reflects the limited set of Carriers specified by this end user, and provide carrier selection data to the querying switch based on the bids of this set of Carriers only.

The bidding process can also accommodate those end users (and resellers) who wish to employ a strategy of purchasing telecommunications service at the lower of the bid price in the auction or a negotiated price they agreed to pay a telecommunications service provider under a term contract. The Moderator or the subscribing switch can include this contract price received from such end user, along with the bids it evaluates each time telecommunications

service is provided to this end user (or the customers of a reseller). If the contract price is lower than all of the other bids, the contract Carrier could be selected as the Carrier of choice for that end user (or reseller). If the contract price is higher than any of the other bids, the low bidder could be selected instead. The contract price could serve as a ceiling while the end user (or reseller) can still capture the benefit of low prices made available via the bidding process (e.g., at night when system-wide excess capacity is greater than during peak daytime periods). To ensure that this end user (or reseller) can satisfy the volume commitments that would likely be part of any attractively-priced contract, the Moderator could enable this end user (or reseller) to designate from time to time (e.g., during certain peak demand daytime hours) that the contract price is to be treated as the low bid available to that end user (or reseller) at that time. At other times the Moderator will consider all bids submitted by other carriers as well as such contract price.

Routing decisions for each route or route segment of a call attempt may be made using the auction process at each switching point (i.e., at the originating switching point or any of the intermediate switching points on the same or different telecommunications networks) as a call attempt is presented to each respective switch. Routing decisions may also be made (e.g., by a central entity such as the Moderator) for all route segments comprising the entire route of a call attempt, from its originating switching point through any and all

intermediate switching points to its terminating switching point, at each respective switching point before the call attempt is routed (e.g., in a manner conceptually similar to the call set-up process used today in SS7 signaling networks). Alternatively, routing decisions may be made using the auction process at any switching point for any group of route segments constituting less than all of the route segments comprising an entire route of a call attempt (e.g., for the remaining portion of a route from any intermediate switching point to its terminating switching point) before the call attempt is routed by that switching point.

As illustrated in Figure 9, routing decisions for a call attempt can be made at an originating switching point 82 as well as at intermediate switching points 3 on one or more telecommunications networks, based on bid information and/or carrier selection data transmitted by the Moderator over a data link 8 to the respective switching point presented with the call attempt. ISP stands for Intermediate Switching Point.

On certain types of telecommunication networks (e.g., packet data networks), a call attempt presented to a switch, for which a routing decision can be made, may consist of all or only part of the message or information (whether voice, data, video, etc.) being transmitted during the call by the calling party to the called party. For example, on packet data networks, when a calling party sends a data file to the called party, the network infrastructure would break up this file into a series of individual packets that are separately addressed and transmitted to

the called party. Each of these packets may cross over different route segments in traveling from the originating switching point to the terminating switching point. Each packet can be treated as a call attempt by (i) the originating switching point for the entire route or (ii) by the originating switching point and each of the intermediate switching points to which the packet is presented for each of the route segments. And a routing decision can be made for each packet at each such switching point.

The transmission of bid information between the Carriers and the Moderator is a feed back process as illustrated, for example, in Figure 5. Each Carrier transmits 28 its economic incentive bids to the Moderator and the Moderator transmits 21 received bids to each Carrier or at least the portion of the Carriers appropriate to each bid. The Carrier starts its bid formulation by collecting 24 network data, such as the capacity and traffic loading of each network facility, and transmitting 25 this network data to the Carrier's network management computer. The network data can be entered by keying it in or entered over a data link from the Carrier's network operations systems. The Carrier's network administrator enters (e.g., by keying them in or by data link) network management instructions, such as the fact that a particular facility is being taken out of service for maintenance or has a trouble that reduces its transmission capacity. The network management instructions could also be based on network performance characteristics, such as response time, or competitive

business factors, such as the intent to compete more intensively for traffic to a specific region of the county or over routes or route segments that compete directly with another specified Carrier.

Software within each Carrier's network management computer then accesses its memory for the network data, the network management instructions, and the bid data received from the Moderator and determines 27 the economic incentive the Carrier will bid for traffic over each route or route segment. These data are accessed by means of the data buses and registers commonly internal to a computer. These bids are stored in the computer memory and transmitted 28 to Moderator. Since the network management computer has access to the bids of other Carriers, during each bidding cycle each Carrier has the opportunity to adjust its bids in view of the bids of the other Carriers for traffic over each route or route segment. This adjustment may be accomplished automatically by the software in response to the network management instructions, or may be accomplished by direct input from the network administrator viewing displayed bidding data. The result of such adjustment consideration may be a decision to leave the bid as originally calculated, as being appropriate to accomplish the network administrator's objective.

Figure 10 illustrates a network architecture that enables large users 61 that route telecommunications traffic to Carriers 62 over dedicated access lines 63, 64 to take advantage of a bidding arrangement. This architecture can be

employed by large users who wish to send their telecommunications traffic over different types of networks (e.g., circuit-switched, frame relay, asynchronous transfer mode, packet data, etc.) and use different classes of telecommunications service provided by such networks (e.g., transmission of voice, data, video, etc.). In this architecture a bidding Moderator 60 transmits the processed bidding data over a data link 65 independent of the dedicated access facilities 63, 64 carrying the calls from the users 61 to an auction switch 59 equipped with input and output ports adapted to receive dedicated facilities 63, 64, 66. The bidding data link 65 is also independent of any common channel signaling network associated with the dedicated facilities 63, 64, 66. The dedicated access facilities 63 may be connected, for example, through a local exchange telephone carrier's local central office 67 (or the equivalent local equipment of another provider of local access to a telecommunication network) or routed directly 64 from the user's PBX 61 (or other hardware or software-driven originating equipment) to the auction switch 59. The users 61 will, typically, also have switched access facilities 68 to a local exchange telephone carrier's local central office 67.

This dedicated facility auction switch 59 has a switching matrix for switching calls and a software directed switch controller for selecting a Carrier 62 for a call, based on carrier selection data resulting from the bidding process, and routing the call to the selected Carrier 62 for a call, based on carrier selection data resulting from the bidding process, and routing the call to the selected Carrier 62.

The call is switched to the dedicated Carrier facility 66 connected to the selected Carrier 62, perhaps by way of a serving wire center 69. Through this architecture large users 61 sending telecommunications traffic over dedicated facilities can benefit from the bidding process and, for traffic sent by users to the public telephone network, for example, such users can avoid the access charges imposed by local exchange telephone carriers on central office switched access traffic. Even though a dedicated facility 63 may connect through a local exchange telephone carrier's local central office 67, it is given a dedicated, unswitched connection, not triggering the imposition of a switched access rate element.

Some subscribing switches 59 (Subscriber) may be provisioned to treat every call attempt presented to them as a call which is to be routed to the low-bidding Carrier 62 (e.g., a switching point dedicated for use only by calling parties who are customers of the Moderator's bidding service). A calling party may reach such a Subscriber 59 using dedicated access facilities 64 from the calling party's premises equipment 61 (e.g., a PBX) to the Subscriber 59, as illustrated in Figure 10. In the alternative, a calling party without such dedicated access facilities may reach a subscribing switch by means of a routing code stored at the calling party's originating switching point indicating to the originating switching point that calls from this calling party are to be routed first to the subscribing auction switch (Auction Switch). In the existing public switched telephone network, a calling party's local exchange switch (or an associated

access tandem switch) recognizes the calling party's unique identifier (i.e., its telephone number) and routes call attempts for destinations outside the local calling area to the local point-of-presence of the calling party's presubscribed or primary interexchange carrier, based on a unique carrier access code stored at the switch identifying that carrier and associated with the calling party identifier by the calling party's local exchange carrier as part of its local switching infrastructure. Using a similar approach, a unique carrier access code can also be designated for the Auction Switch. Calling parties who elect to become customers of the Moderator's bidding service, but do not have dedicated access facilities to the Auction Switch, can be assigned the Auction Switch's carrier access code. The calling party's local exchange carrier will then incorporate the Auction Switch's unique carrier access code into its local switching infrastructure in lieu of the designation for that calling party of a presubscribed or primary interexchange carrier's unique carrier access code. Thereafter, all call attempts by this calling party to non-local destinations will be routed by the local exchange switch to the Auction Switch, which can then route such call attempts to the low-bidding Carrier selected by the Moderator or the Auction Switch.

As illustrated in Figures 14 and 15, the routing decision for a call attempt can be made at an Auction Switch 90, based on bid information and/or carrier selection data transmitted by the Moderator 89 over a data link 8 to the Auction Switch 90 perhaps by an adjunct computer with a data link to the Auction

Switch. The call attempt can be routed to the Auction Switch 90 by the local exchange telephone carrier's local exchange switch 91 as illustrated in Figure 14, or by that carrier's access tandem switch 92, as illustrated in Fig. 15, if non-local call attempts are sent by that carrier's local exchange switch 91 to the tandem switch 92 before the local exchange carrier associates the calling party identifier (i.e., its telephone number) with the carrier access code for the calling party's presubscribed or primary interexchange carrier.

In the existing public switched telephone network, a calling party can override its presubscribed or primary carrier designation by inputting a different carrier access code before the call attempt's routing data when attempting to make a call (e.g., inserting a 5-digit code "10XXX" identifying the alternative carrier before the particular NPA-NXX-XXXX being dialed). In the same fashion, a calling party who wishes to make use of the Moderator's bidding service only as an alternative to the calling party's presubscribed or primary interexchange carrier may do so by inputting the Auction Switch's unique carrier access code before the call attempt's routing data (e.g., the particular NPA-NXX-XXXX being dialed). This call attempt will then be routed to the Auction Switch 90, which can then route such call attempt to the selected low-bidding Carrier's point of presence 88.

In some cases, the Subscriber function can be incorporated in a more generally capable switching point (e.g., a local exchange switch or

equivalent local switching node) handling call attempts from calling parties who are customers of the Moderator's auction service and from other calling parties who are not (e.g., a calling party with a presubscribed or primary interexchange carrier). In that case, when a call attempt is presented to such a Subscriber capable switching point, the Subscriber 91 can use the calling party's unique identifier (e.g., the calling party's telephone number or electronic mail address) to determine whether this calling party 61 is or is not a customer of the Moderator's auction service.

Many local exchange telephone carriers, for example, use intelligent network architectures well known in the art to offer features or classes of service to their customers based on the local exchange switch's ability to recognize the calling party's telephone number. Each calling party can elect to subscribe for one or more of the available classes of service. The local exchange switch (with its intelligent network capabilities) can associate the calling party's unique telephone number with the specific classes of service to which that calling party has subscribed. One such class of service which local telecommunications service providers, such as local exchange telephone carriers, could offer to calling parties is the Moderator's bidding service.

As illustrated in Figure 16, the routing decision for a call attempt using the auction service can be made at the local exchange telephone carrier's local exchange switch 91 which, through a software defined portion of its

software control, can serve as a subscribing switching point for a calling party who subscribes for a class of service utilizing the Moderator's auction service. Such routing decision can be based on the bid information and/or carrier selection data transmitted by the Moderator over a data link 8 to the suitably enhanced local exchange switch (a Subscriber-capable switch) 91', perhaps by way of an adjunct computer 93 with a data link 94 to the local exchange switch 91'. As illustrated in Figure 17, if a local exchange telephone carrier implements this class of service at its access tandem switch 92', which has been suitably enhanced to incorporate the Subscriber function, the routing decision for a call attempt can be made in a software defined portion of the tandem switch 92', based on bid information and/or carrier selection data transmitted by the Moderator 89 over a data link 8 to the enhanced tandem switch 92' (the subscribing tandem switch), perhaps by way of an adjunct computer 96 with a data link 95 to the tandem switch 92'.

In many public switched telephone network architectures a local exchange carrier will use an access tandem switch serving several local exchange switches to supplement the computing capabilities of the local switches it serves. In such cases all calls requiring routing outside of each local exchange switch's local serving area are sent to the access tandem switch. The access tandem switch contains the network intelligence and information needed to route such calls to other switches, including Carriers' points of presence. If the user identifier transmitted with the call attempt identifies an authorized user of an auction

service, the access tandem switch routes the call attempt to the selected Carrier's point of presence or a switch dedicated to the auction service (an Auction Switch) or a software defined portion of a switch of more general utility. The call attempt may carry with it an access code, which may be a carrier access code, designating the call as an auction service call

This telephone network architecture is an example of a more general communication architecture placing different levels of intelligence and functionality at different positions in the architecture. For the purposes of this disclosure the "access tandem" concept will be used to designate the first switching point in a communication architecture at which a decision is made to route a call attempt to one of several possible Carriers or to an Auction Switch.

In selected cases, a Subscriber-capable switch may be instructed to treat call attempts received from callers identified as customers of one or more telecommunication service providers (e.g., customers of a switchless reseller) as calls for which routing decisions are to be based on the auction process. These call attempts might reach the Subscriber-capable switch via public switched access facilities or dedicated facilities from the telecommunication service provider originating the call attempt, or the service provider carrying the call attempt over the route segment ending at the Subscriber-capable switch. The switch may distinguish between those call attempts that are to be routed based on the auction process, and those that are not, by any of several means (e.g., calling

party identifier, carrier identification code, or the carrier-specific facilities, if any, over which the call attempt is received).

In certain other cases, a Subscriber-capable switch may be instructed to treat call attempts that have one of a set of destinations specified by the Moderator or the switch administrator, as subject to the auction process. This may be done, perhaps, at the request of the end user or the telecommunications service provider originating the call or carrying the call to the subscriber-capable switch (e.g., the subscriber, situated in New York City, will select the low-bidding Carrier for all call attempts it receives that have destinations in downtown Chicago). Such a call attempt can reach the Subscriber-capable switch using any of the methods described in the preceding paragraphs.

In order not to require each end user subscribing to the bidding arrangement to establish a billing relationship with each Carrier taking part in the bidding process, a central billing arrangement is advantageous. In the billing arrangement illustrated in Figure 11, the bidding and routing takes place as illustrated in Figure 5 or Figure 8. After the switch routes a call 33, it transmits the call completion data identifying the call source, the Carrier, the applicable route or route segment data, and any other information necessary for billing purposes (e.g., the time and duration of the call) to a computer associated with the Moderator. The Moderator transmits economic incentive data to this computer. The computer associates the call completion information with this economic

incentive data in its memory to form a billing record of the call, which is stored in a billing data base. Periodically (e.g., at the end of each billing period) this computer sorts the billing records by call source identifier and generates a bill.

As an alternative to a computer associated with the Moderator preparing bills, a local exchange telephone carrier, for example, can generate bills for those of its customers participating in the bidding process as callers, by having a computer associated with one or more switches receive economic incentive data from the Moderator and call completion data from the switch. This computer associates the bidding information with the call completion information in its memory to form a billing record of the call, which is stored in a billing data base. Periodically, the computer sorts the billing records by call source identifier and generates a bill.

Figure 12 illustrates a process by which the Moderator transmits bids directly to end users for traffic originating in a specified local exchange area (e.g., an NPA-NXX or group NPA-NXXs on the public switched telephone network, including a group comprising all NPA-NXXs in the North American Numbering Plan) and terminating anywhere. Here the Moderator receives bids 34 as before. However, the bids are independent of terminating point. The Moderator processes the data to sort it by originating point to determine 35 which bids apply to which end users, each end user having an interface unit to receive and store the data. The Moderator then transmits 36 the bid data and/or carrier

selection data for a particular local exchange area to the interface units of all subscribing end users in such local exchange area (e.g., all subscribing end users served by the local exchange switch for a specific NPA-NXX), as interface unit information. The information may be displayed for evaluation by the end user or processed, within the interface unit, with direction from the end user, and all outgoing calls routed to the selected Carrier. If the Carrier information is displayed for the end user, the end user can choose a Carrier for a call attempt and key in the selected Carrier's carrier identification code before the desired destination address (e.g., telephone number). If the information is processed automatically within an interface unit, in the line or wireless connection between the end user's terminal equipment and the local exchange switch (or equivalent local switching node) or a Carrier's point of presence, the interface unit can, for example, automatically insert the appropriate carrier identifier in the outgoing telephone numbers. The interface unit could be a stand-alone piece of equipment, an attachment incorporated into the end user's terminal equipment or a software-defined portion of the end user's terminal equipment.

At the end user, the degree of automation of the process depends on the particular telecommunication terminal equipment being used. If the terminal equipment is a simple telephone, the telecommunicator function 37 specified in Figure 12 may consist of the end user reading the bids from a display screen in the interface unit, making the routing decision, and routing 38 the call

attempt by keying in the selected Carrier access code. If the terminal equipment is more complex, such as a personal computer or other microprocessor-containing equipment, the decision can be software implemented. The Carrier access code could be inserted by the terminal equipment or by the interface unit, if the interface unit is in the end user's telecommunication access line or wireless connection to the telecommunication network.

Figure 13 illustrates the interface unit's position within the bidding architecture of Figure 12. The interface unit 39 receives bid data or carrier selection data from the Moderator 40 over a telecommunication facility that may be a wire link 44 or a wireless link 45. The interface unit has either a wired input port or contains a wireless receiver (e.g., radio or optical). The interface unit 39 is in the telecommunication path between the telecommunicator and the external telecommunication network, such as the local exchange switch 42 that routes the call to the selected Carrier 43 in response to the Carrier access code. The interface unit may have a separate end user input port 46 for use by the end user to key in the selected Carrier access code each time a call is placed. The end user may also be able to key in a Carrier selection and the interface unit may contain a tone generator or digital signal generator necessary to automatically insert the Carrier access identification code for each call attempt. The interface unit 39 may also have a screen to display the bid information to the end user.

CLAIMS

What is claimed is:

1. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunications Carriers and distributes processed data to at least a first subscribing auction switch equipped to implement an auction service, of a plurality of subscribing auction switches, thereby enabling the first auction switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first auction switch, based on an economic choice, wherein the method comprises:

a) receiving the call attempt in an originating switch, including a caller identifier;

b) associating the caller identifier with a presubscribed first carrier access code identifying the first auction switch;

c) routing the call attempt to the first auction switch;

d) selecting the first Carrier on the basis of the processed data; and

e) routing the call attempt to the first Carrier.

2. A method of Claim 1 in which the step of associating the caller identifier with the first carrier access code is performed at the originating switch.

3. A method of Claim 1 in which the step of associating the caller identifier with the first Carrier access code is performed at an access tandem switch associated with the originating switch.

4. A method of Claim 1 in which the processed data includes economic incentive data and the selecting is performed based on the economic incentive data.

5. A method of Claim 1 in which the processed data includes Carrier selection data and the selecting is performed based on the Carrier selection data.

6. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunications Carriers and distributes processed data to at least a first subscribing auction switch equipped to implement an auction service, of a plurality of subscribing auction switches, thereby enabling the first auction switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first auction switch, based on an economic choice, wherein the method comprises:

a) receiving the call attempt in an originating switch, including a caller identifier and an access code associated with the auction service;

b) confirming that the caller identifier is associated with a caller that is an authorized auction service user;

c) routing the call attempt to the first auction switch;

d) selecting the first Carrier on the basis of the processed data; and

e) routing the call attempt to the first Carrier.

7. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunication Carriers, and distributes processed data to at least a first subscribing originating switch equipped to implement an auction service, thereby enabling the first subscribing originating switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first subscribing originating switch, based on an economic choice, wherein the method comprises:

a) receiving in the first subscribing originating switch a call attempt including a caller identifier and an access code associated with the auction service;

b) confirming that the caller identifier is associated with a caller that is an authorized auction service user;

c) selecting the first Carrier based on the processed data; and

d) routing the call attempt to the first Carrier.

8. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunication Carriers, and distributes processed data to at least a first subscribing access tandem equipped to implement an auction service, thereby enabling the first subscribing access tandem to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first subscribing access tandem, based on an economic choice, wherein the method comprises:

a) receiving in the first subscribing access tandem a call attempt including a caller identifier and an access code associated with the auction service;

b) confirming that the caller identifier is associated with a caller that is an authorized user of the auction service;

c) selecting the first Carrier based on the processed data; and

d) routing the call attempt to the first Carrier.

9. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunication Carriers, and distributes processed data to at least a first subscribing originating switch equipped to implement an auction service, thereby

enabling the first subscribing originating switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first subscribing originating switch, based on an economic choice, wherein the method comprises:

a) receiving in the first originating switch a call attempt including a caller identifier;

b) associating the caller identifier with a class of service that utilizes the processed data;

c) selecting the first Carrier based on the processed data; and

d) routing the call attempt to the first Carrier.

10. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunication Carriers, and distributes processed data to at least a first subscribing access tandem equipped to implement an auction service, thereby enabling the first subscribing access tandem to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first subscribing access tandem, based on an economic choice, wherein the method comprises:

a) receiving in the first access tandem a call attempt including a caller identifier;

b) associating the caller identifier with a class of service utilizing the processed data;

c) selecting the first Carrier based on the processed data; and

d) routing the call attempt to the first Carrier.

11. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers and user-specific data from a plurality of users, processes the economic incentive data and user-specific data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunications Carriers and distributes processed data to at least a first subscribing auction switch equipped to implement an auction service, of a plurality of subscribing auction switches, thereby enabling the first auction switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first auction switch, based on an economic choice, wherein the method comprises:

a) receiving the call attempt in an originating switch, including a caller identifier;

b) associating the caller identifier with a presubscribed first carrier access code identifying the first auction switch;

c) routing the call attempt to the first auction switch;

d) selecting the first Carrier on the basis of the processed data; and

e) routing the call attempt to the first Carrier.

12. A method of Claim 11 in which the user-specific data includes designation of a default Carrier.

13. A method of Claim 11 in which the user-specific data includes rate information negotiated between a user and a contract Carrier designated by the user.

14. A method of Claim 11 including specification of the time interval in which the user-specific information is valid.

15. A method of Claim 11 in which the user-specific data includes designation of a portion of the plurality of telecommunications Carriers acceptable to the user.

16. A method of Claim 11 in which the plurality of users includes telecommunication service resellers.

17. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers and user-specific data from a plurality of users, processes the economic incentive data and user-specific data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunication Carriers, and distributes processed data to at least a first subscribing originating switch equipped to implement an auction service, thereby

enabling the first subscribing originating switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first subscribing originating switch, based on an economic choice, wherein the method comprises:

a) receiving in the first subscribing originating switch a call attempt including a caller identifier and an access code associated with the auction service;

b) confirming that the caller identifier is associated with a caller that is an authorized user of the auction service;

c) selecting the first Carrier based on the processed data; and

d) routing the call attempt to the first Carrier.

18. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers and user-specific data from a plurality of users, processes the economic incentive data and user-specific data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunication Carriers, and distributes processed data to at least a first subscribing originating switch equipped to implement an auction service, thereby enabling the first subscribing originating switch to select a first Carrier of the plurality of telecommunication Carriers for a call attempt presented to the first subscribing originating switch, based on an economic choice, wherein the method comprises:

a) receiving in the first originating switch a call attempt including a caller identifier;

b) associating the caller identifier with a class of service that utilizes the processed data;

c) selecting the first Carrier based on the processed data; and

d) routing the call attempt to the first Carrier.

19. A method of Claim 18 in which the user-specific data includes an instruction to treat all calls terminating at switching points outside of a defined geographic area as auction service calls.

20. A method of Claim 18 in which the user-specific data includes an instruction to treat all calls terminating at switching points of a defined plurality of switching points as auction service calls.

21. A method for controlling a telecommunication network in which a moderating computer collects economic incentive data from each Carrier of a plurality of telecommunications Carriers, processes the economic incentive data, distributes at least a portion of the economic incentive data to at least a portion of the plurality of telecommunications Carriers and distributes processed data to at least a first subscribing auction switch equipped to implement an auction service, of a plurality of subscribing auction switches, thereby enabling the first auction switch to select a first Carrier of the plurality of telecommunication Carriers for a call

attempt presented to the first auction switch, based on an economic choice, wherein the method comprises:

a) receiving the call attempt in the first auction switch over a first facility limited to auction service calls;

b) selecting the first Carrier on the basis of the processed data; and

c) routing the call attempt to the first Carrier.

22. A method of Claim 21 in which the processed data includes economic incentive data and the selecting is performed based on the economic incentive data.

23. A method of Claim 21 in which the processed data includes Carrier selection data and the selecting is performed based on the Carrier selection data.

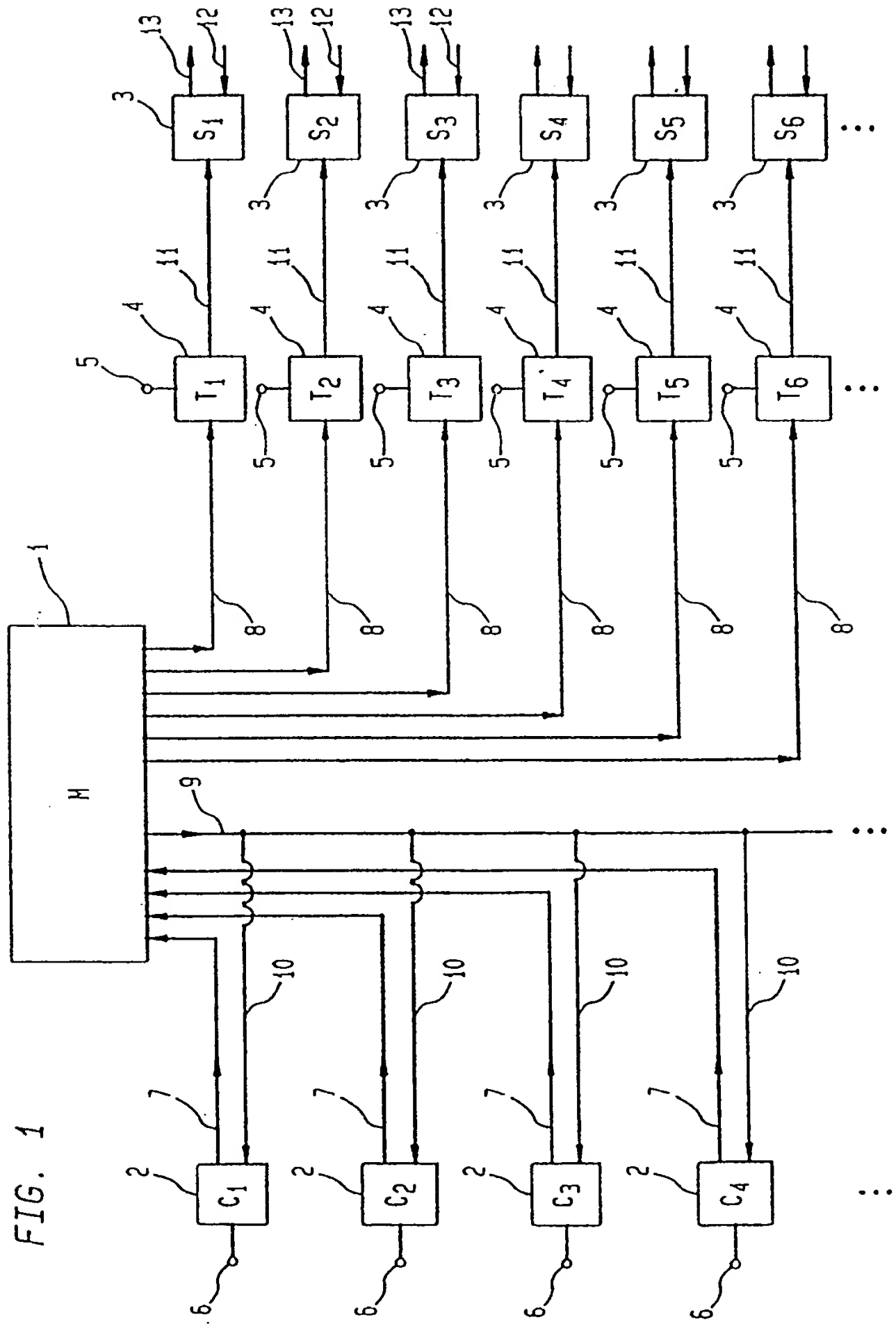

1
H
2
C1
C2
C3
C4
3
S1
S2
S3
S4
S5
S6
4
T1
T2
T3
T4'
T5
T6
5
6
7
8
9
10
11
12
13

FIG. 1

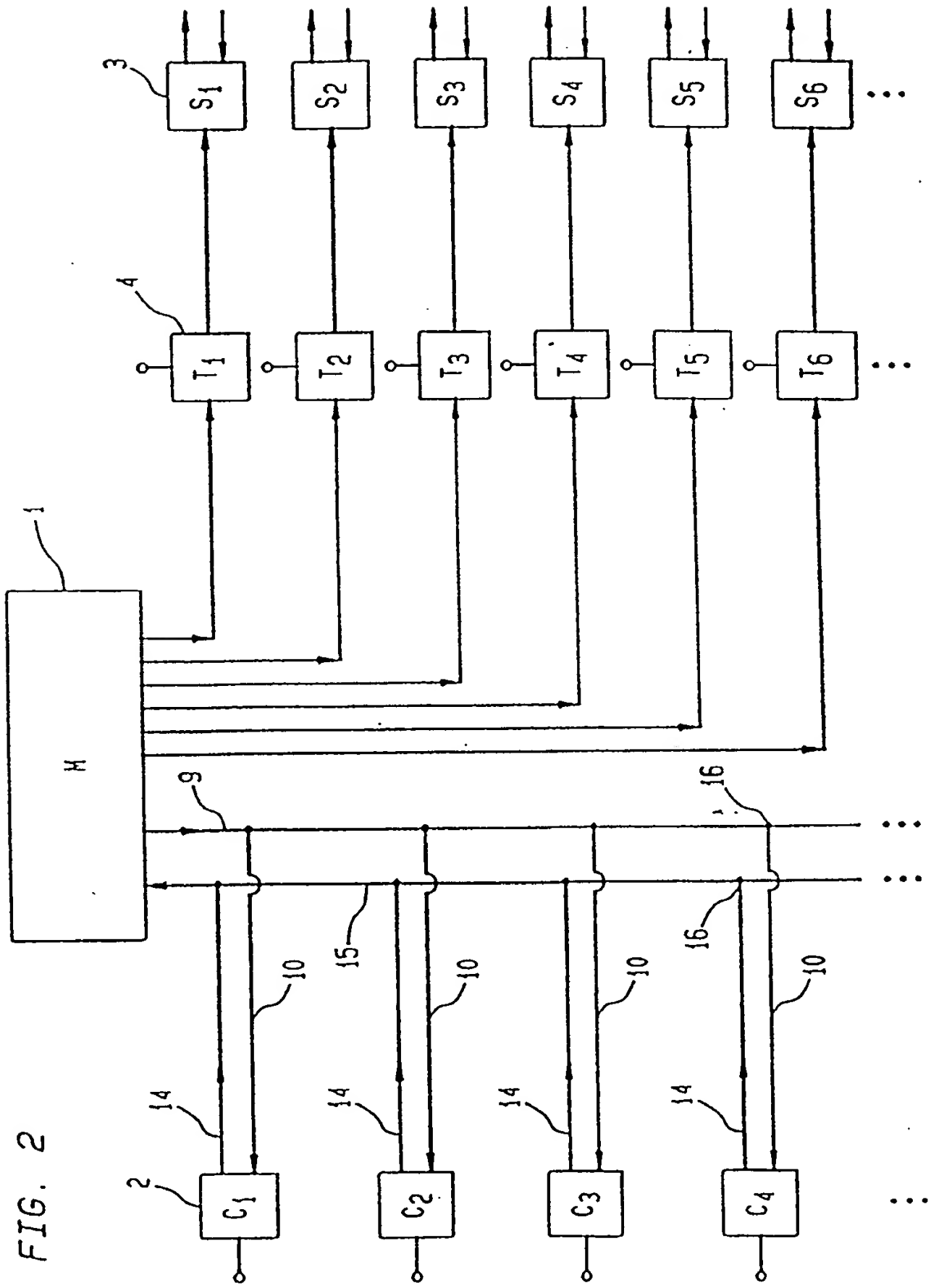


FIG. 2

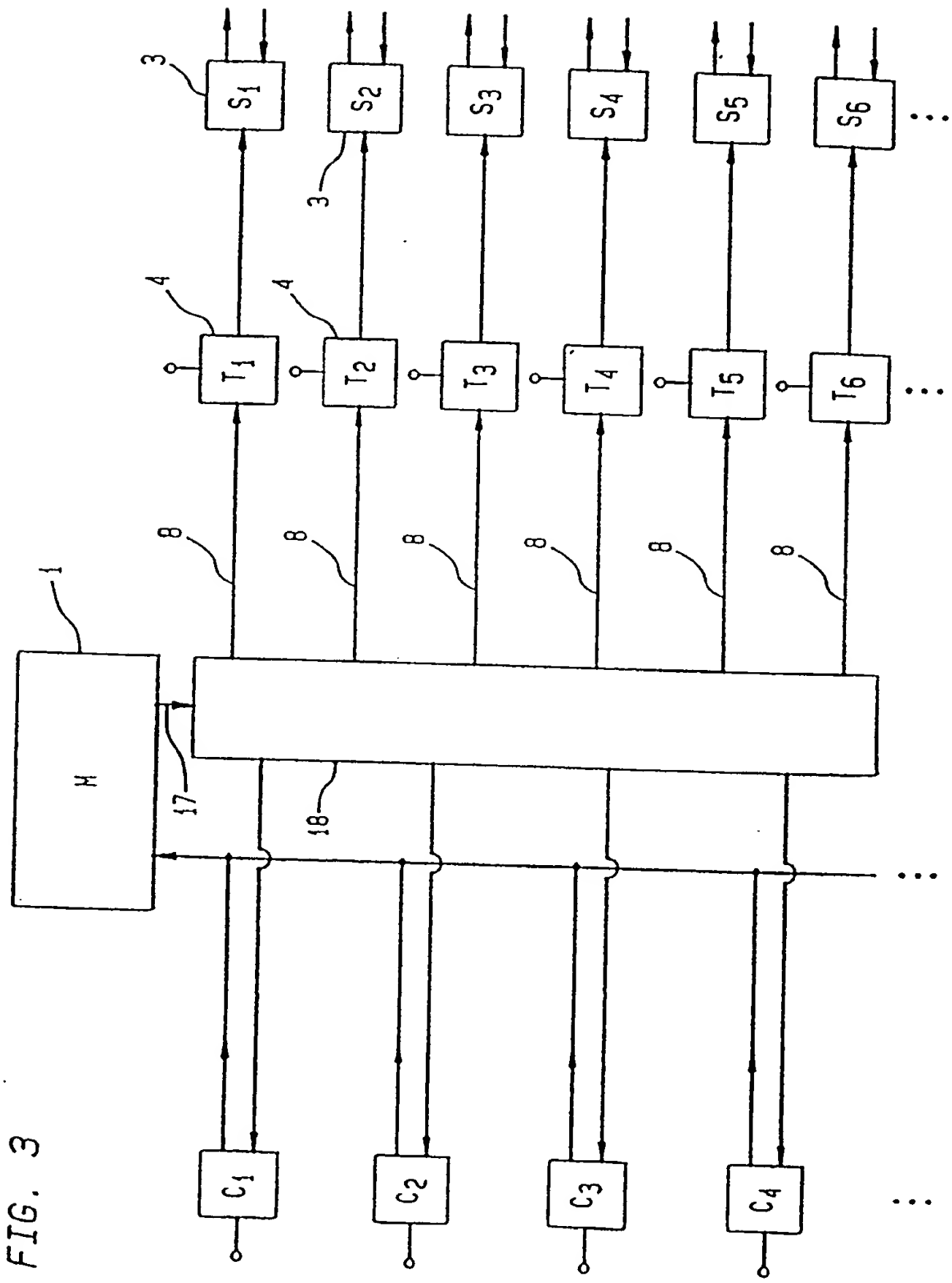


FIG. 3

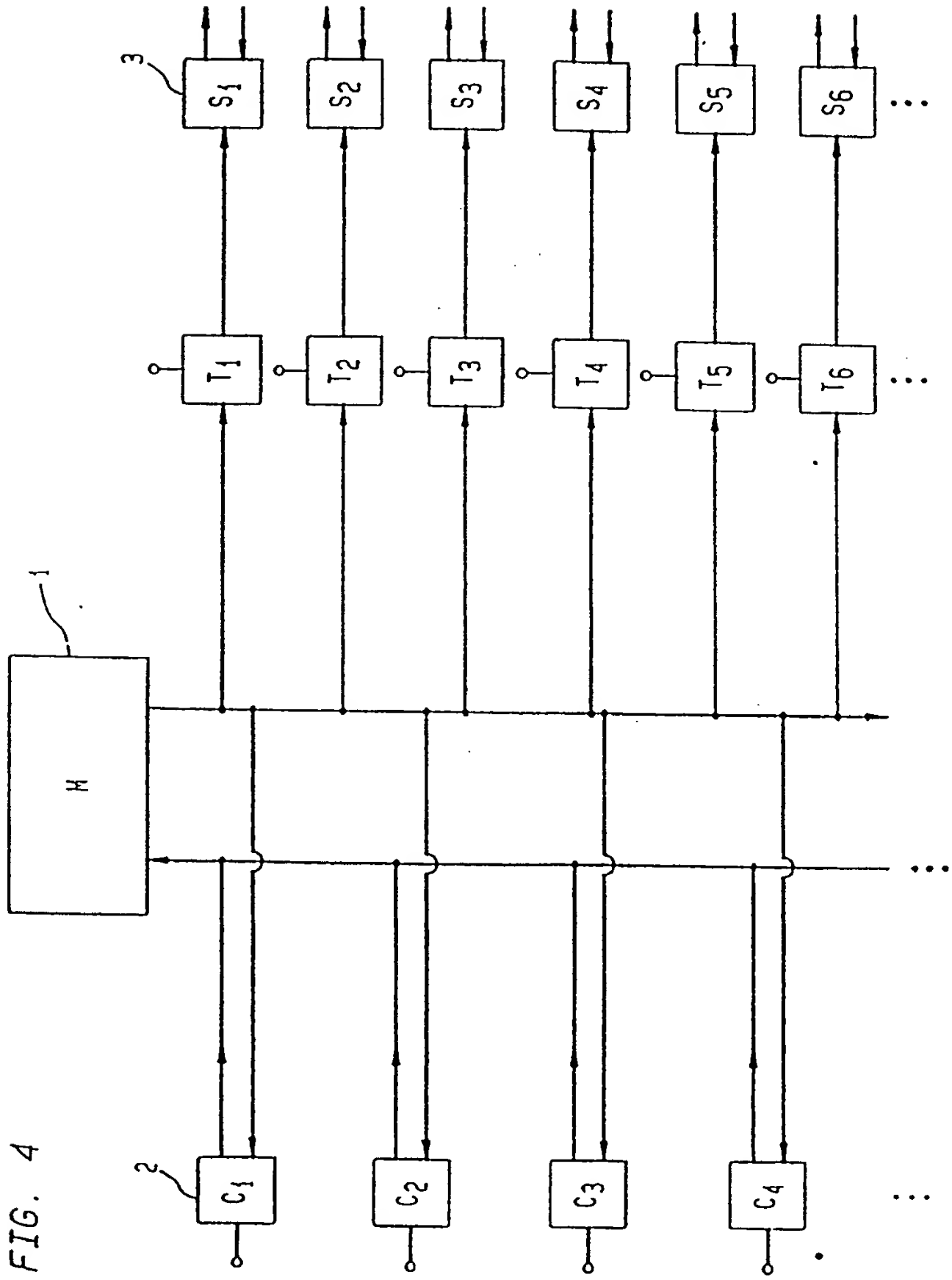
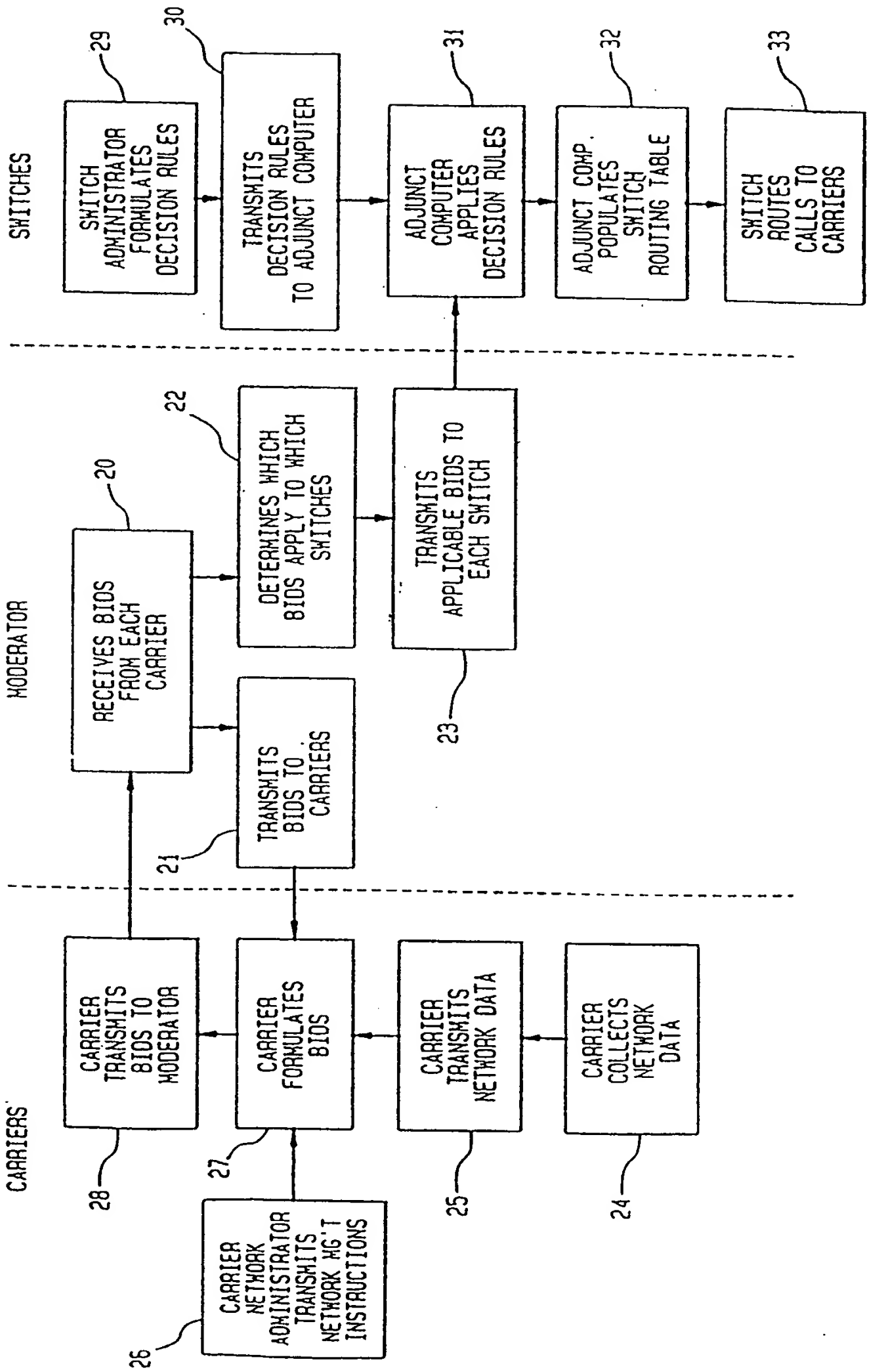


FIG. 4

FIG. 5


SWITCHES
MODERATOR
CARRIERS
SWITCH ADMINISTRATOR FORMULATES DECISION RULES
29
TRANSMITS DECISION RULES TO ADJUNCT COMPUTER
30
ADJUNCT COMPUTER APPLIES DECISION RULES
31
ADJUNCT COMP. POPULATES SWITCH ROUTING TABLE
32
SWITCH ROUTES CALLS TO CARRIERS
33
RECEIVES BIDS FROM EACH CARRIER
20
DETERMINES WHICH BIDS APPLY TO WHICH SWITCHES
22
TRANSMITS APPLICABLE BIDS TO EACH SWITCH
23
TRANSMITS BIDS TO CARRIERS
21
CARRIER TRANSMITS BIDS TO MODERATOR
28
CARRIER FORMULATES BIDS
27
CARRIER TRANSMITS NETWORK DATA
25
CARRIER COLLECTS NETWORK DATA
24
CARRIER NETWORK ADMINISTRATOR TRANSMITS NETWORK MG'T INSTRUCTIONS
26

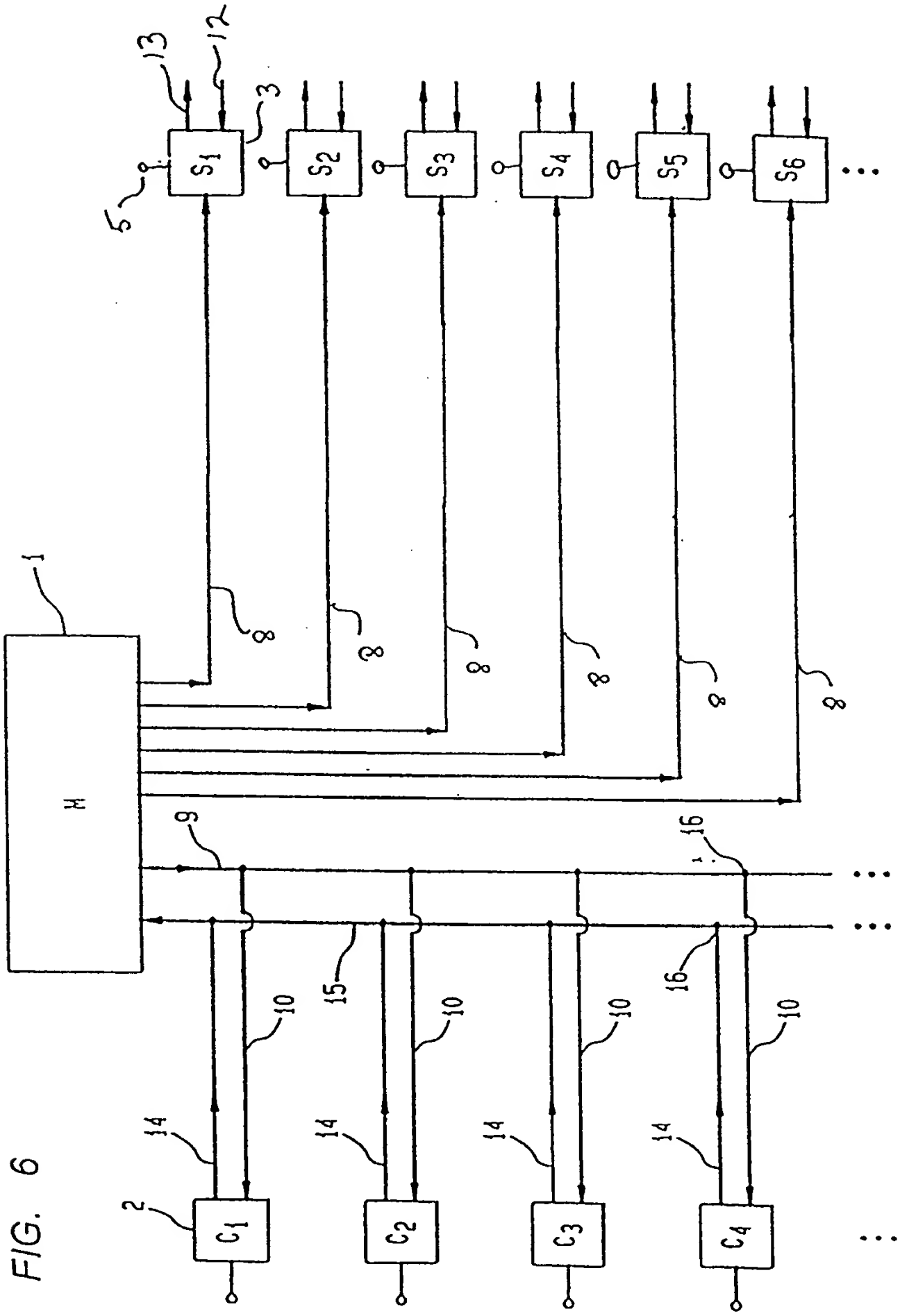


FIG. 6

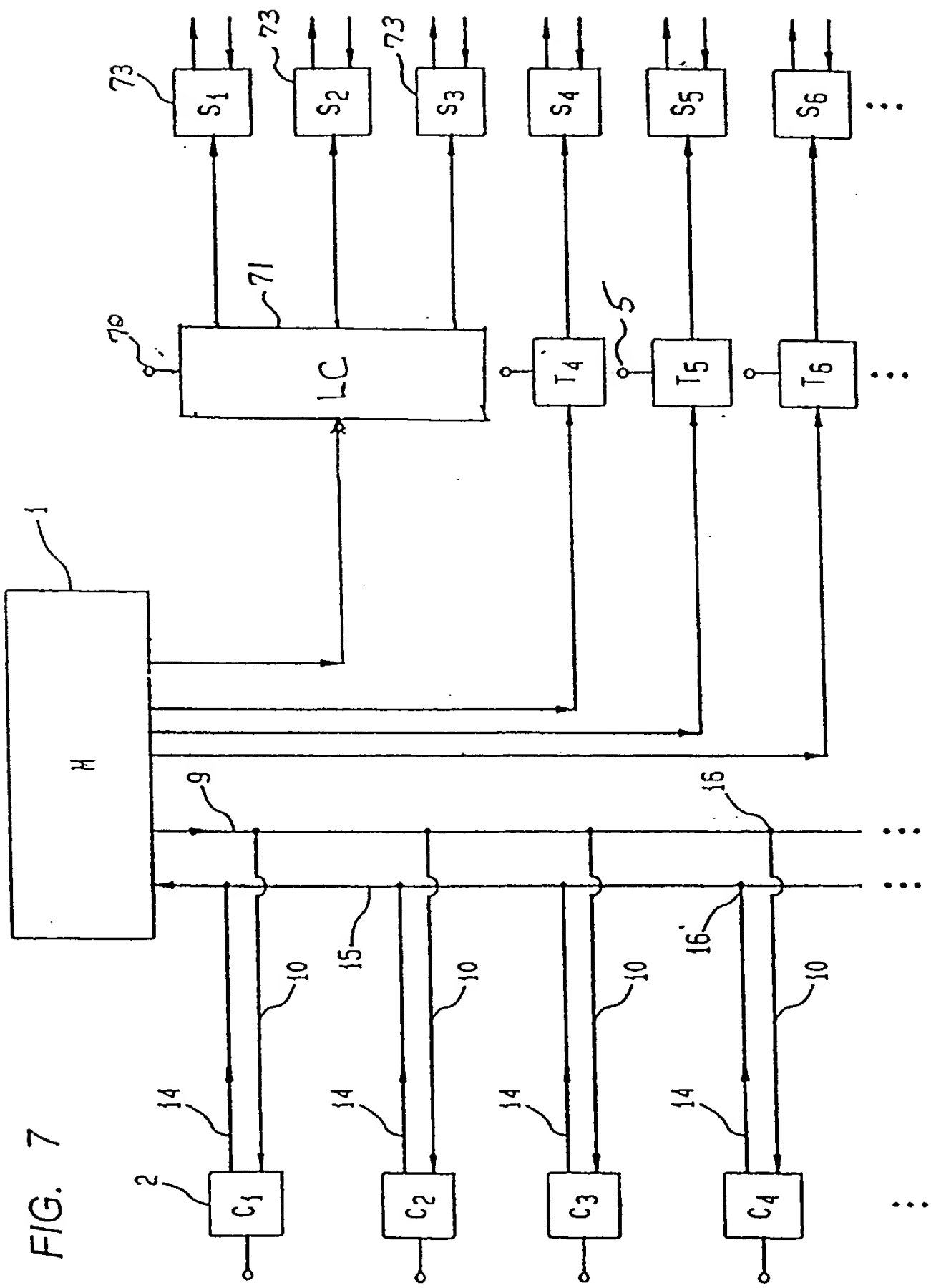


FIG. 7

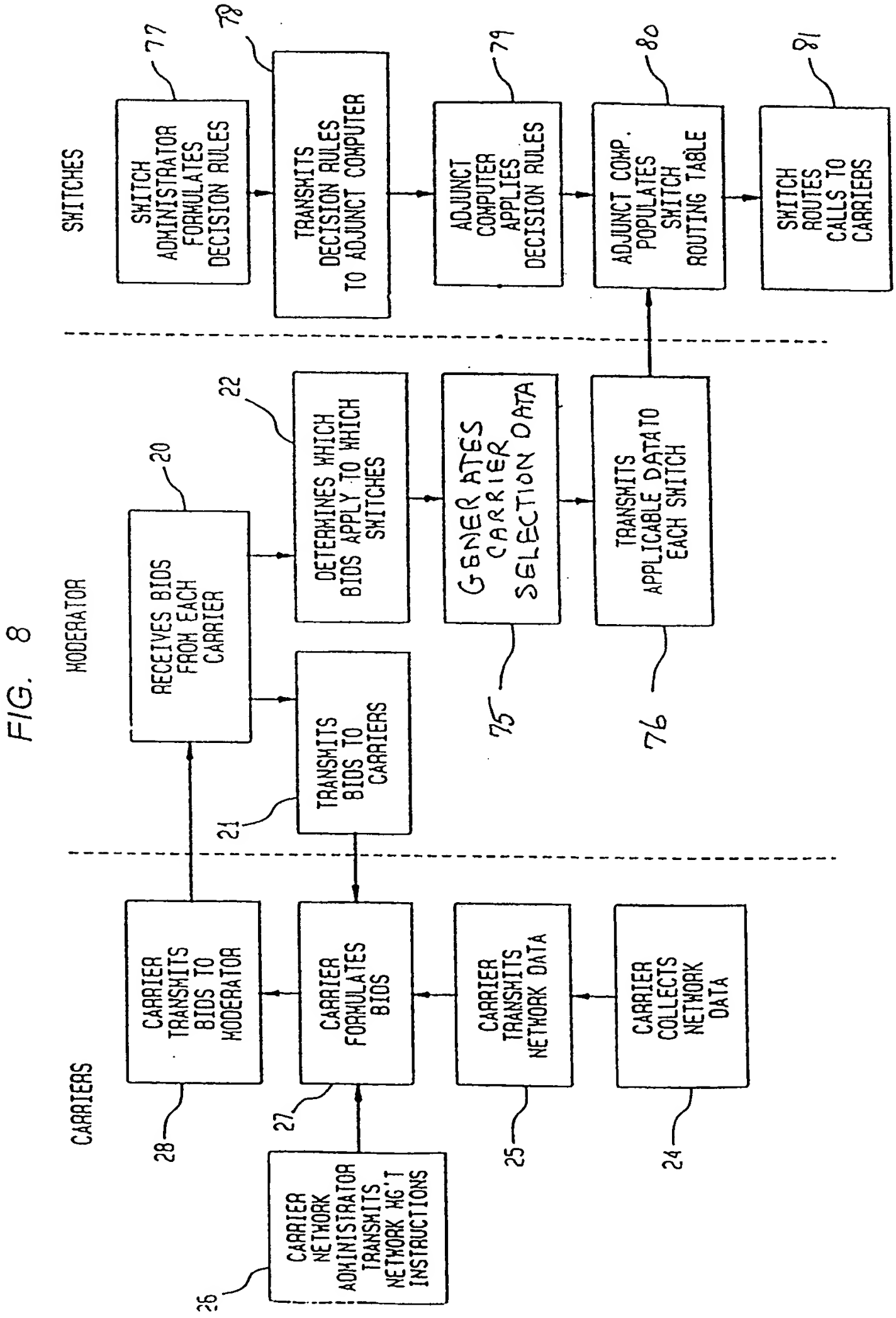

SWITCHES
SWITCH ADMINISTRATOR FORMULATES DECISION RULES
77
TRANSMITS DECISION RULES TO ADJUNCT COMPUTER
78
ADJUNCT COMPUTER APPLIES DECISION RULES
79
ADJUNCT COMP. POPULATES SWITCH ROUTING TABLE
80
SWITCH ROUTES CALLS TO CARRIERS
81
MODERATOR
RECEIVES BIDS FROM EACH CARRIER
20
DETERMINES WHICH BIDS APPLY TO WHICH SWITCHES
22
GENERATES CARRIER SELECTION DATA
75
TRANSMITS APPLICABLE DATA TO EACH SWITCH
76
TRANSMITS BIDS TO CARRIERS
21
CARRIERS
CARRIER TRANSMITS BIDS TO MODERATOR
28
CARRIER FORMULATES BIDS
27
CARRIER TRANSMITS NETWORK DATA
25
CARRIER COLLECTS NETWORK DATA
24
CARRIER NETWORK ADMINISTRATOR TRANSMITS NETWORK MG'T INSTRUCTIONS
26

FIG. 8

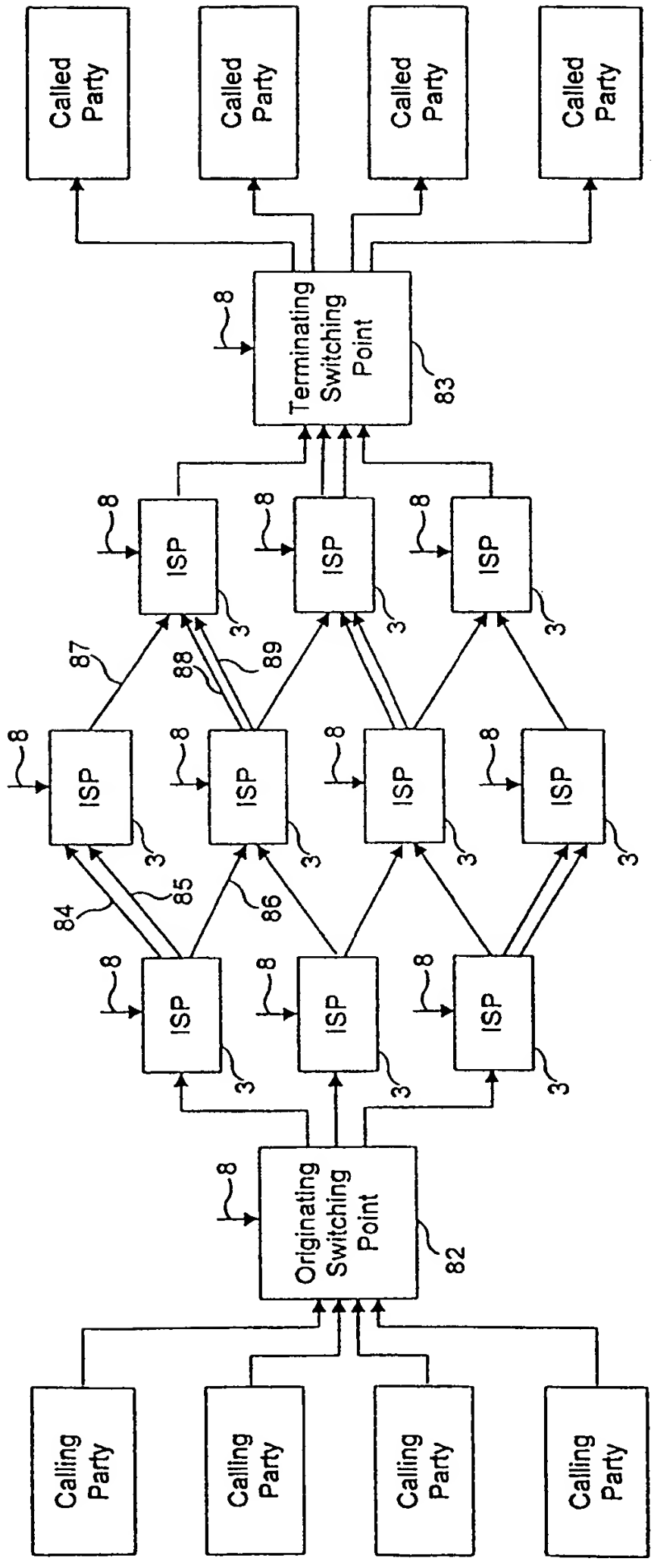

Called Party
Called Party
Called Party
Called Party
Terminating Switching Point
83
8
ISP
3
87
88
89
84
85
86
Originating Switching Point
82
Calling Party
Calling Party
Calling Party
Calling Party

FIG. 9

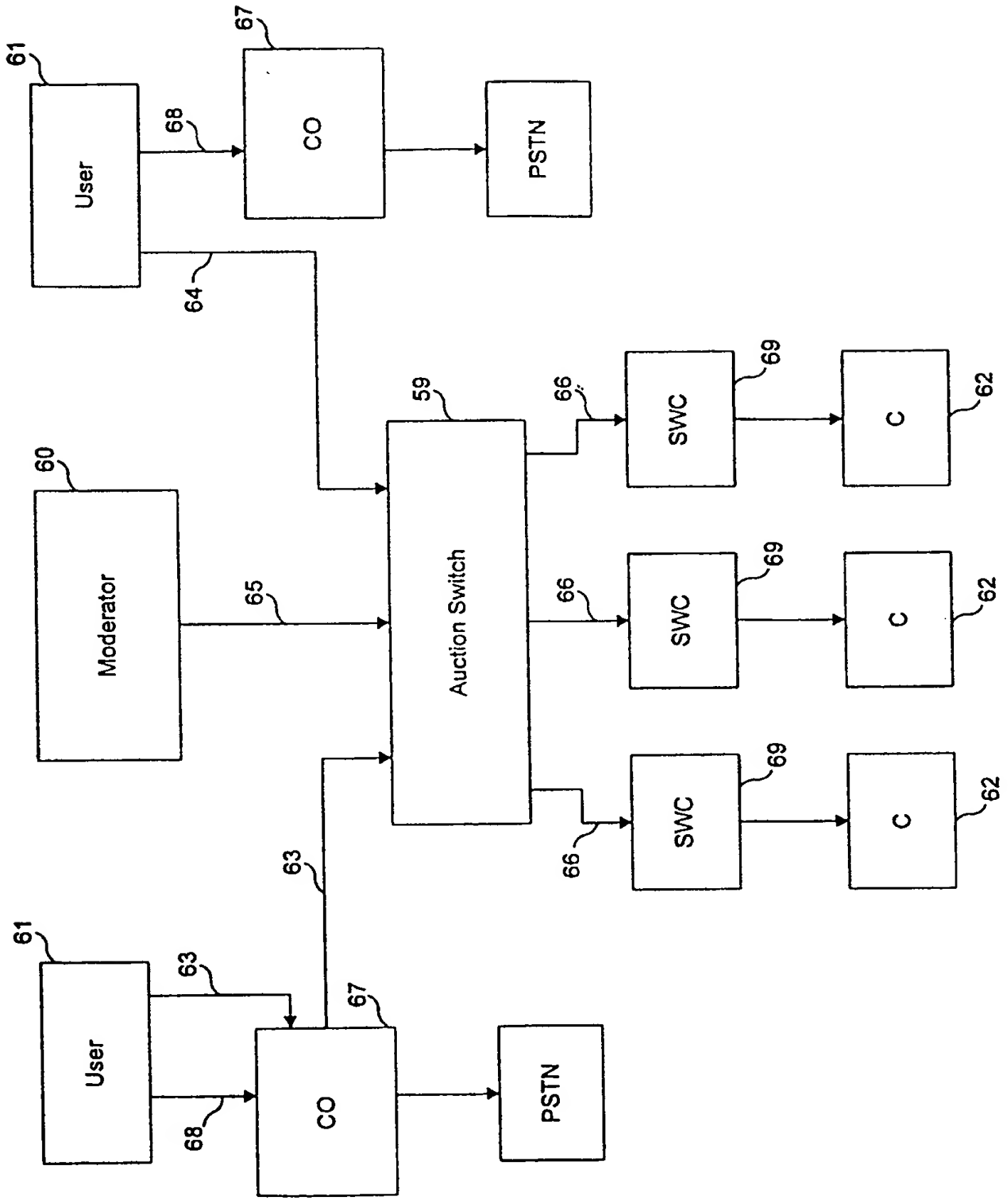

61
67
User
68
CO
PSTN
64
59
66
SWC
69
C
62
60
Moderator
65
Auction Switch
66
SWC
69
C
62
63
66
SWC
69
C
62
61
63
67
User
CO
PSTN
68

FIG. 10

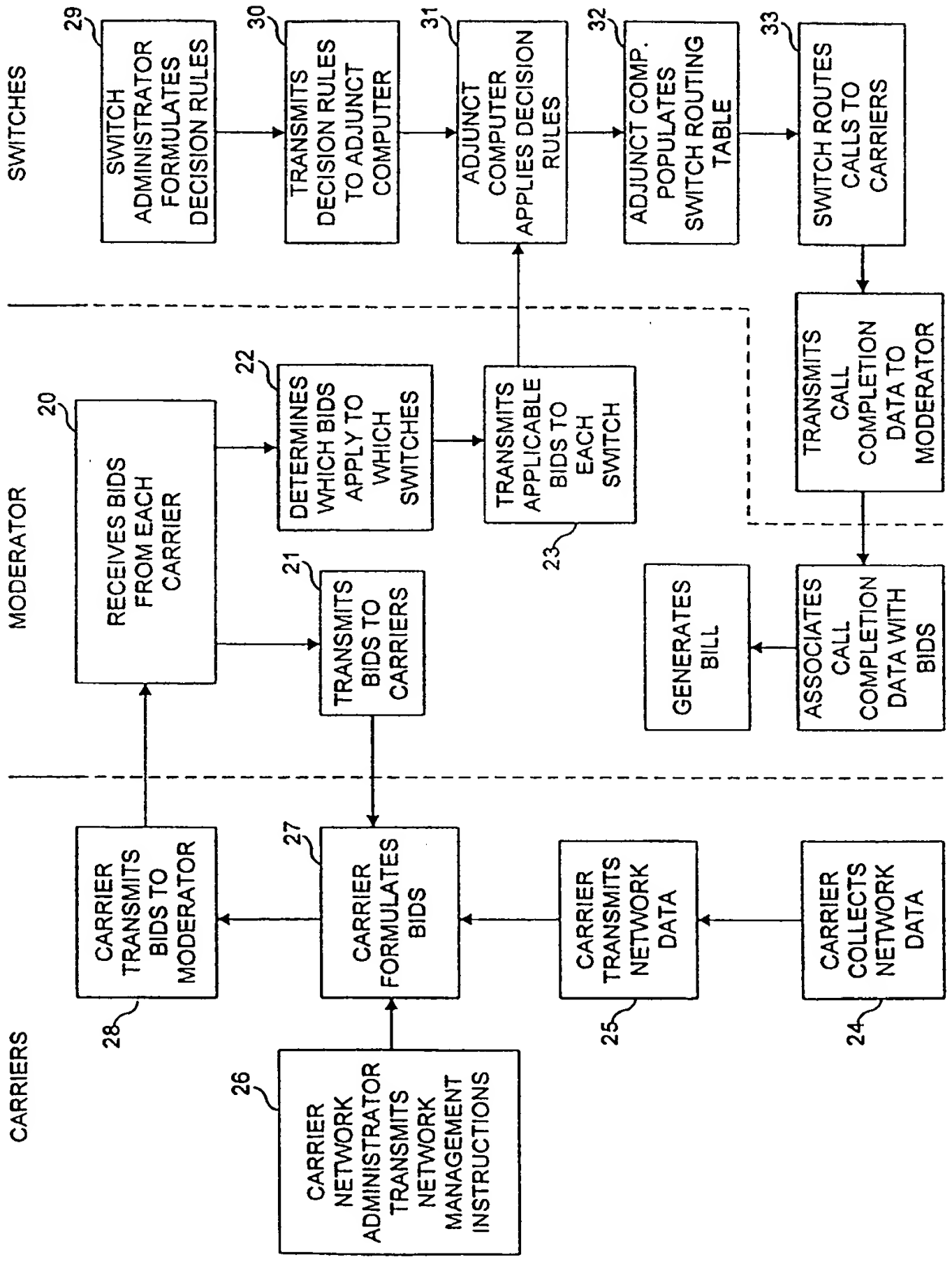
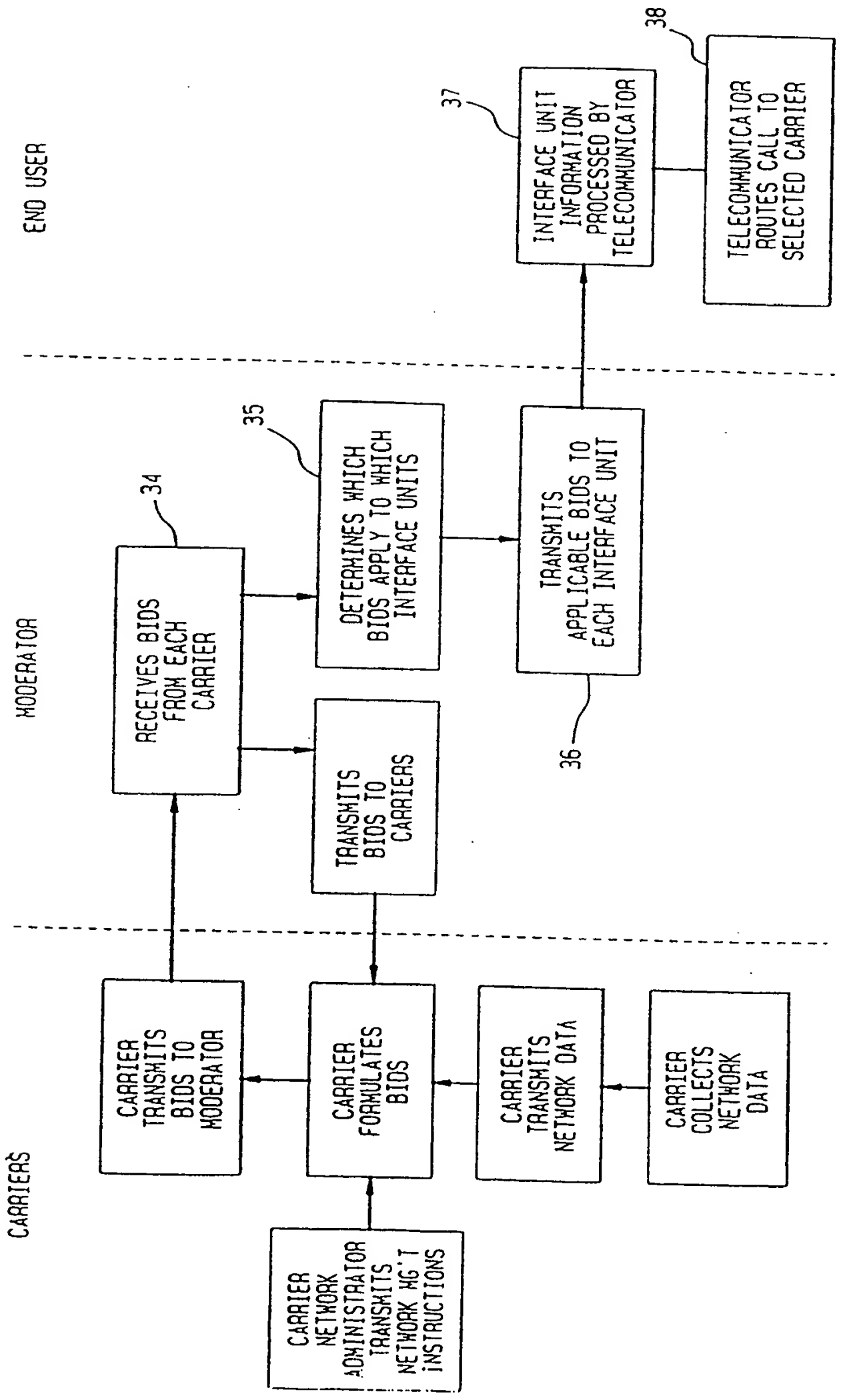

SWITCHES
29
SWITCH ADMINISTRATOR FORMULATES DECISION RULES
30
TRANSMITS DECISION RULES TO ADJUNCT COMPUTER
31
ADJUNCT COMPUTER APPLIES DECISION RULES
32
ADJUNCT COMP. POPULATES SWITCH ROUTING TABLE
33
SWITCH ROUTES CALLS TO CARRIERS
TRANSMITS CALL COMPLETION DATA TO MODERATOR
MODERATOR
20
RECEIVES BIDS FROM EACH CARRIER
22
DETERMINES WHICH BIDS APPLY TO WHICH SWITCHES
TRANSMITS APPLICABLE BIDS TO EACH SWITCH
23
21
TRANSMITS BIDS TO CARRIERS
GENERATES BILL
ASSOCIATES CALL COMPLETION DATA WITH BIDS
CARRIERS
CARRIER TRANSMITS BIDS TO MODERATOR
28
27
CARRIER FORMULATES BIDS
CARRIER TRANSMITS NETWORK DATA
25
CARRIER COLLECTS NETWORK DATA
24
26
CARRIER NETWORK ADMINISTRATOR TRANSMITS NETWORK MANAGEMENT INSTRUCTIONS

FIG. 11

FIG. 12


END USER
MODERATOR
CARRIERS
RECEIVES BIDS FROM EACH CARRIER
34
DETERMINES WHICH BIDS APPLY TO WHICH INTERFACE UNITS
35
TRANSMITS APPLICABLE BIDS TO EACH INTERFACE UNIT
36
INTERFACE UNIT INFORMATION PROCESSED BY TELECOMMUNICATOR
37
TELECOMMUNICATOR ROUTES CALL TO SELECTED CARRIER
38
TRANSMITS BIDS TO CARRIERS
CARRIER TRANSMITS BIDS TO MODERATOR
CARRIER FORMULATES BIDS
CARRIER TRANSMITS NETWORK DATA
CARRIER COLLECTS NETWORK DATA
CARRIER NETWORK ADMINISTRATOR TRANSMITS NETWORK MG'T INSTRUCTIONS

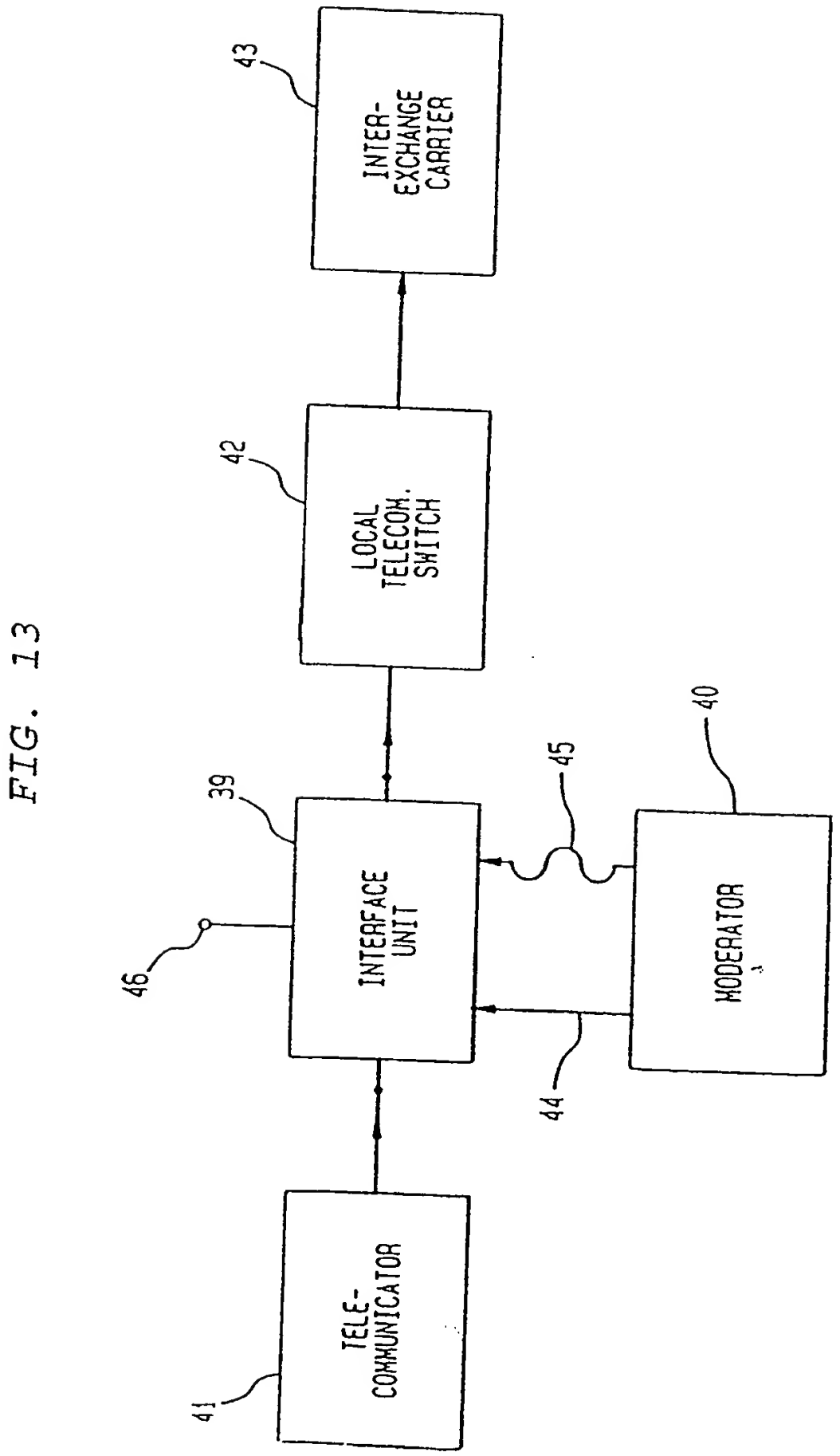

43
INTER-EXCHANGE CARRIER
42
LOCAL TELECOM. SWITCH
39
INTERFACE UNIT
45
40
MODERATOR
46
44
41
TELE-COMMUNICATOR

FIG. 13

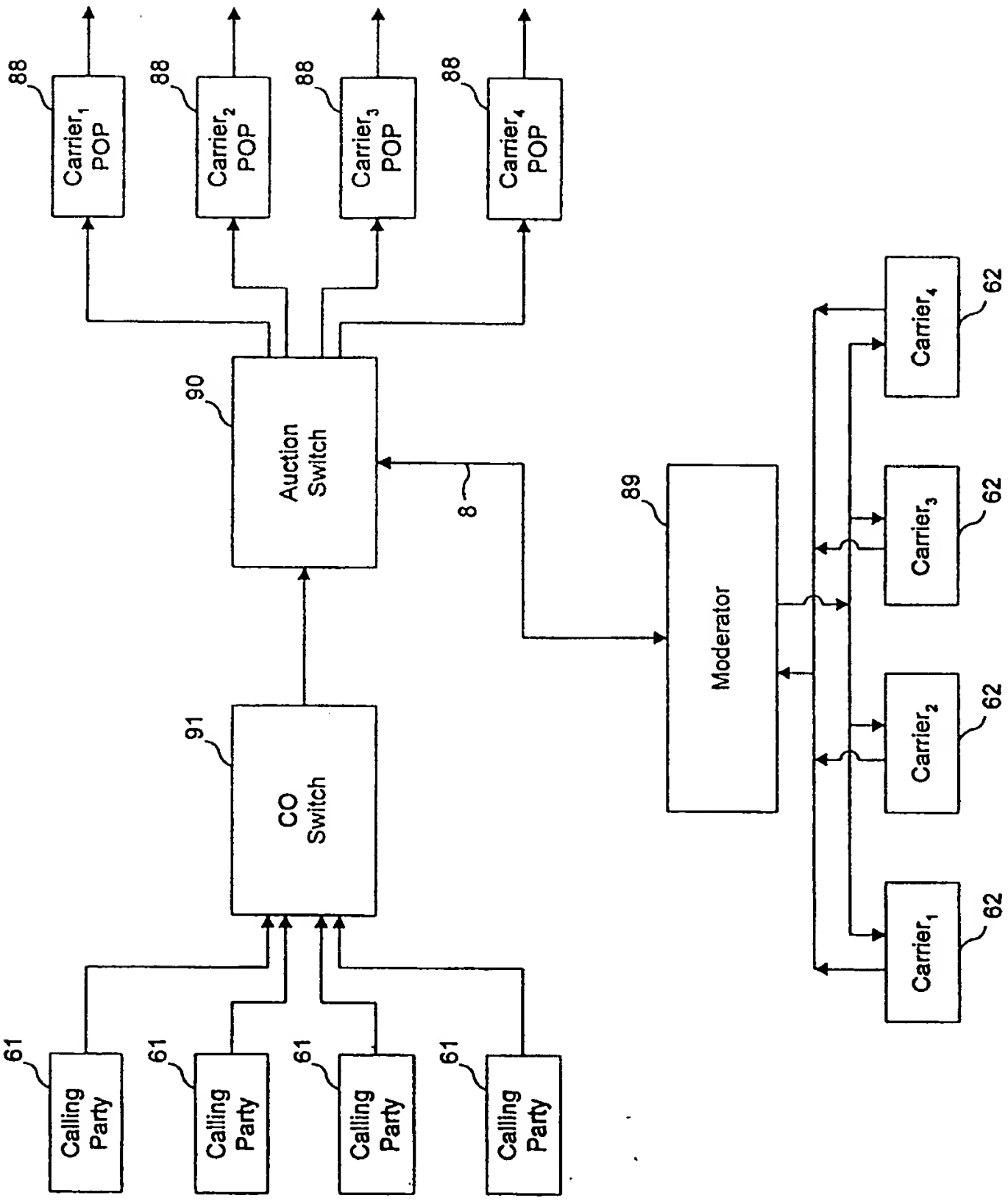

Carrier1 POP
Carrier2 POP
Carrier3 POP
Carrier4 POP
88
Auction Switch
90
8
89
Moderator
Carrier4
Carrier3
Carrier2
Carrier1
62
CO Switch
91
Calling Party
61

FIG. 14

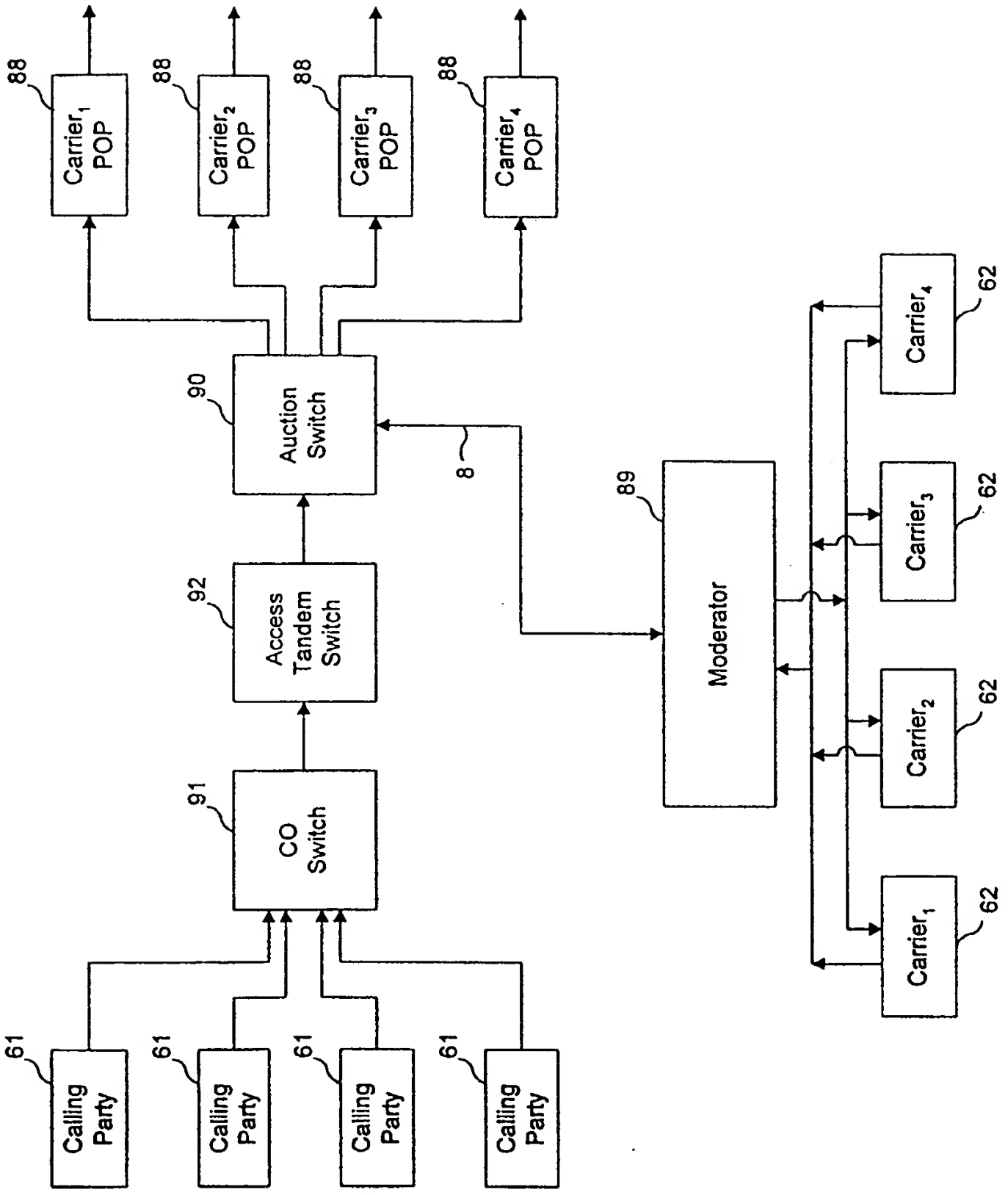

Carrier1 POP
Carrier2 POP
Carrier3 POP
Carrier4 POP
88
Auction Switch
90
8
Access Tandem Switch
92
CO Switch
91
Calling Party
61
Moderator
89
Carrier4
Carrier3
Carrier2
Carrier1
62

FIG. 15

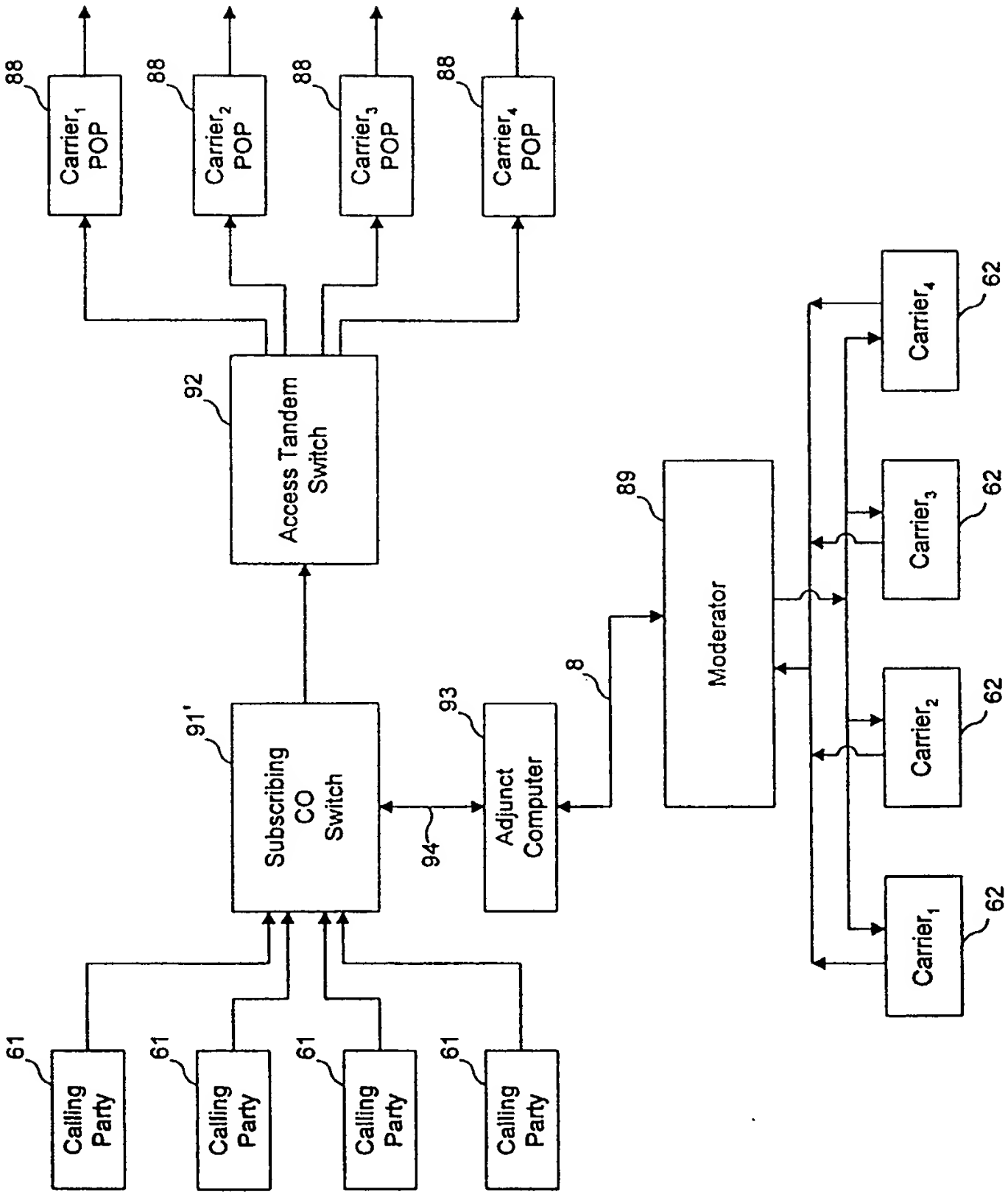

Carrier1 POP
Carrier2 POP
Carrier3 POP
Carrier4 POP
88
Access Tandem Switch
92
Subscribing CO Switch
91'
Adjunct Computer
93
94
Moderator
89
8
Carrier4
Carrier3
Carrier2
Carrier1
62
Calling Party
61

FIG. 16

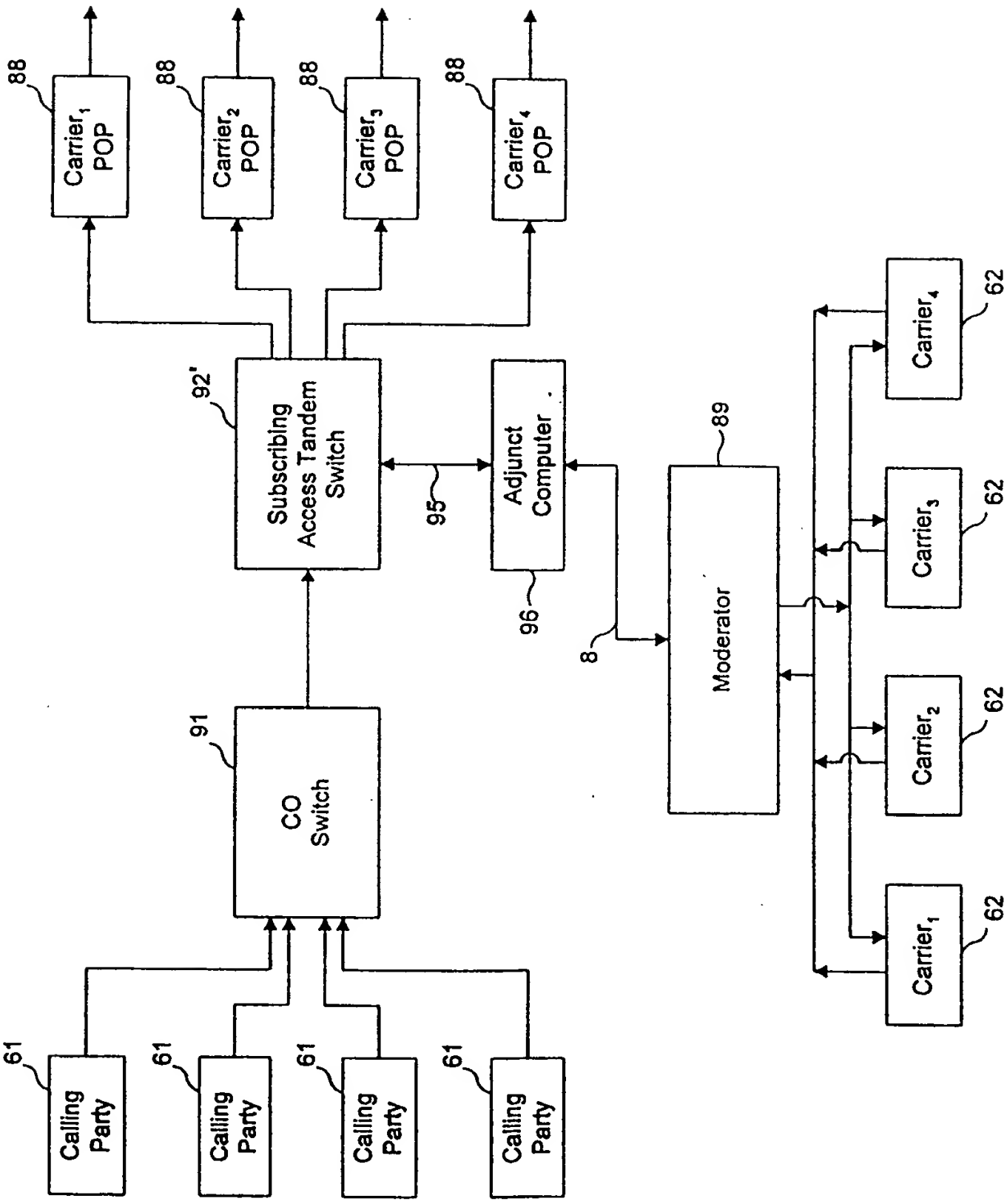

Carrier1 POP
Carrier2 POP
Carrier3 POP
Carrier4 POP
88
Subscribing Access Tandem Switch
92'
Adjunct Computer
95
96
89
Moderator
8
CO Switch
91
Calling Party
61
Carrier1
Carrier2
Carrier3
Carrier4
62

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/01867

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04J 3/12
US CL :370/522

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,606,602 A (JOHNSON et al) 25 February 1997, see Figs. 4-6, col. 4, lines 9-14 and 50-56.	1-23
Y	US 5,508,999 A (COX, Jr. et al) 16 April 1996, see Figs. 1-3, col. 3, lines 65-67, col. 4, lines 1-48, and col. 6, lines 5-13.	1-23
Y	US 5,566,236 A (MELAMPY et al) 15 October 1996, see Figs. 3-4, col. 7, lines 41-67, col. 8, lines 1-67, and col. 9, lines 1-39.	3, 8, and 10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 07 APRIL 1999	Date of mailing of the international search report 19 APR 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer PHIRIN SAM Eugenia Zogan Telephone No. (703) 308-9294

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/01867

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

370/522, 238, 345, 351, 353, 354, 355, 360, 395, 400, 401, 402, 411, 252, 259; 379/14, 84, 88.19, 88.21, 100.04, 207, 209, 220, 224, 225, 231, 232, 234, 243, 245, 258, 335